THE WEEK'S EVENTS

South Penn Turnpike Gets Big Grant

New policy of joint RFC-PWA financing is inaugurated eliminating PWA loans

In approving a grant of $26,000,000 to the Pennsylvania Turnpike Commission for construction of the proposed Harrisburg-Pittsburgh toll road, PWA on July 30 brought the total construction cost of approved projects over the billion mark to $1,046,617,000. At the same time, the big project marked the inauguration of a new policy by which large self-liquidating projects may be financed jointly by RFC and PWA. Under the new plan, PWA resources will be conserved by restricting its activities to the actual grant, while RFC provides a loan to meet the rest of the expense.

The proposed 162-mile toll road will largely follow the right-of-way and use the roadbed of the old South Penn R.R., on which construction was started in 1881 but which was never finished. The old railroad right-of-way includes nine partially completed tunnels, one of them more than a mile long.

Plans call for a divided roadway, four lanes wide, except in tunnel, where the road will consist of two wide lanes. The roadway will make no intersections at grade, and the right-of-way will be protected against local encroachments.

Detailed terms of the RFC loan,

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EAST SECTION OF SAN JACINTO TUNNEL HOLED THROUGH

B. C. LEADBETTER, general superintendent of construction on the San Jacinto tunnel, closed a firing switch at 10:28 p.m. July 28 to shoot the final round in the 6¾-mi. eastern section of the tunnel, under construction since April, 1933. Completion of excavation on the Cabazon-Lawrence leg of the 13-mi. tunnel leaves 4,800 ft. to be excavated between the Lawrence adit and the Potrero shaft.

San Jacinto will be the last to be completed of 38 tunnels in the 392-mile Colorado Aqueduct of the Metropolitan Water District of Southern California.

An electric clock wired to the shooting switch recorded the exact time that the final round was fired in order to govern the pay-off on a holing-through pool formed by 1,440 aqueduct workers.

Improper Bidding Methods Charged in Detroit

Competitive bidding on PWA projects "is being stifled" in the Detroit area, PWA Administrator Ickes stated last week in a letter to Mayor Reading. Various branches of the construction industry, he said, are preventing free and open competition "through the medium of bid depositories operating with the aid of certain labor unions. This procedure is effecting a crystallization of bid prices for certain items at arbitrarily fixed amounts. . ."

"Our investigation indicates that so-called voluntary trade agreement systems used by plumbing contractors and which have been used by other trades in the construction industry in the Detroit area definitely are in contravention of Public Works Administration requirements and a question has been raised as to whether such practices are in violation of state laws."

Ickes went on to warn the Mayor that "so long as these practices are allowed to continue, pending allotments to the city of Detroit and vicinity are placed in jeopardy . . .

"I feel that the method now used regarding the subletting of contracts in the Detroit area should be thoroughly aired, and that if it is found that prevailing practices are in violation of state statutes, the evidence uncovered in our investigation will be made available to public officers."

Investigations Start On Buchanan Dam

Valley residents claim Colorado River Authority dams were improperly regulated

As a result of the complaints of local residents, Secretary of the Interior Ickes has sent Harry W. Bashore, of the Bureau of Reclamation, to investigate the operation of Buchanan Dam and other facilities of the Lower Colorado River Authority of Texas during recent floods in that area. Considerable damage was caused by flood flows resulting from the heaviest rainfall in 25 years, and it has been charged that this damage was augmented by faulty methods of operation during the period. Mr. Bashore will make an early report as to the truth of these reports.

A second investigation is being started by the Texas legislature. It is expected that this inquiry will get underway by August 8.

Arrangements for the state investigation followed a mass meeting at Austin July 30 at which it was charged that much of the damage done during the flood was caused by the fact that the reservoir behind Buchanan Dam had been allowed nearly to fill. When the first flood warnings were received, the dam was emptied, residents said, at an excessive rate, and when the flood came there was not sufficient capacity to store the flow.

A statement issued by the Lower Colorado River Authority said that had all four dams planned by the authority been in service the flood would have been controlled. The statement denied that there was delay in releasing flood water from Buchanan Dam.

"As soon as the heavy rains were reported, we began to reduce the level of the dam to receive the additional water. The country, however, is one with quick runoff and the area receiving the rain was so close to the dam that floods resulted. . . .

"The CRA has already taken steps to place flood gages on all the tributaries of the Colorado . . ."

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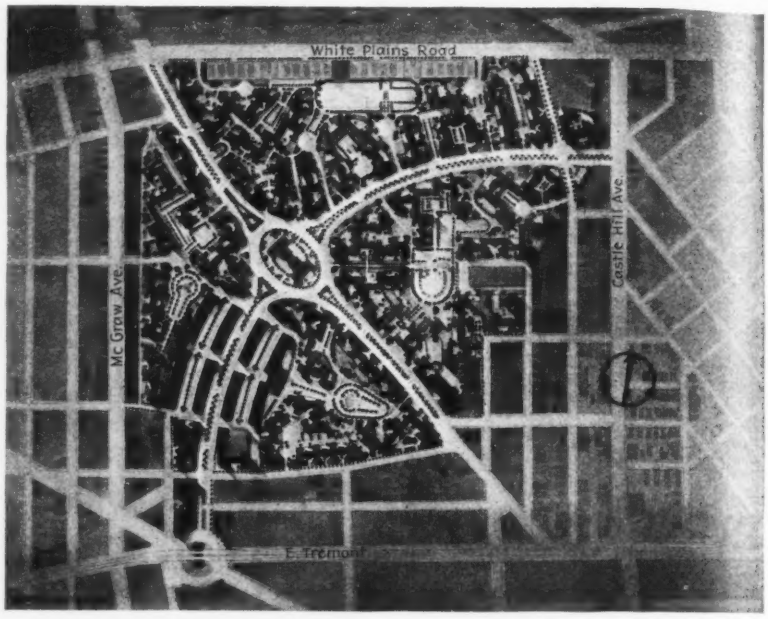
Accurate Snow Surveys

In April this year, the usual snow surveys of the large basin draining into Lake Tahoe on the California-Nevada line were made and were used as the basis for predictions of the annual runoff. Because the outflow from Lake Tahoe is controlled by headgates, it is possible to convert the total runoff into terms of elevation of the lake surface. When computations based on the April surveys were completed the prediction was that in late July, when release of water at the headgates would begin, the lake would have reached El. 6,228.80. This is a level much higher than usual resulting from unusual rainfall last winter. The accuracy of the estimate was demonstrated late in July when the lake surface reached El. 6,228.85



WORK STARTS ON PRIVATE HOUSING PROJECT

AN IMMENSE housing project in the Bronx, New York City, was put under construction this week by its owner, the Metropolitan Life Insurance Co. (*ENR*, April 14, 1938, p. 527).

The 129-acre project, expected to house 12,000 to 20,000 families, is being built under provisions of a new New York State law, permitting insurance companies to invest their funds in low and medium rental housing projects.

Plans so far announced show that the project area will be divided into four quadrants by two diagonal roadways, each 110 ft. wide, the northwest-southeast roadway following an existing street, and the other diagonal being a new road. Buildings within each quadrant will be serviced by driveways.

The apartment buildings, covering about 26 per cent of the ground area, will be of varying size and height, and will range from a capacity of 66 to about 500 apartments. Their layout is based on variations of a cross-shaped unit. Buildings will be of fireproof construction served by automatic elevators. Exterior walls will be of brick.

A plot of several acres in each quadrant will be devoted to a park and another larger park will be provided in the oval at the junction of the two main drives.

Construction is being started in the south quadrant, and nearly all the buildings in this section will be completed by next summer, while the rest will be completed over the two succeeding years.

The project is under the general direction of George Gove, who was for more than ten years secretary of the New York State Board of Housing and is now manager of housing projects for Metropolitan Life. Starrett Bros. & Ecken hold the construction contract.

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Steel Rail Price Is Cut

The price of light steel rails at all basing points was reduced $3 per ton on July 28, bringing the price to $40 a ton. No change has been announced on the heavier sections, which remain at $42.50 a ton.

Small Reservoir Dam Fails in Montana

A water supply reservoir dam about four miles west of Anaconda, Mont., failed July 28, cutting off water supply for the town of Anaconda and doing extensive damage to property in the town.

The dam, owned by the Anaconda Copper Mining Co., was an earth structure with concrete core about forty years old. It had a spillway. About 70,000,000 gal. of water were stored.

According to W. E. Mitchell, general superintendent at Anaconda for the mining company, there were no exceptional circumstances to account for the collapse.

First Power Sold At Bonneville

Sale of the first sizable block of Bonneville power was announced July 27 by administrator J. D. Ross. Power totaling 5,000 kw. is to be sold on a four months' experimental basis to Northwestern Electric Co. of Portland. Delivery will be made at the dam site to the company's 66-kv. line to Vancouver and Portland.

The contract contemplates that Northwestern will pass on some of the power to Portland General Electric at one end of the line and to Pacific Power & Light on the other. In announcing the contract, Ross said that "the real purpose is to tie the several systems together for the purpose of discovering and correcting any engineering difficulties that may be found in attempting to stabilize the various systems."

The sale is for 2,500 kw. of primary power at $17.50 per kw-year and 2,500 kw. of secondary power at $11.50, both prices pro-rated monthly for the four month period.

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Health Service to Study Milwaukee Epidemic

The U. S. Public Health Service has agreed to make a study of the Milwaukee water supply in response to a request by the state board of health. H. W. Streeter, senior sanitary engineer, has been assigned by the service to make the survey (*ENR*, July 21, 1938, p. 69).

The investigation is the result of a controversy between the Milwaukee health commissioner and the state board as to the cause of an epidemic of gastroenteritis last February, the state board contending that the epidemic was caused by the city's water supply while the health commissioner disagrees. (*ENR*, Feb. 24, 1938, p. 286; May 19, p. 701).

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Reservoir Pollution Law Attacked in Connecticut

The right of the Connecticut state commissioner of health to prohibit land owners from swimming in streams tributary to a reservoir is questioned in a suit brought in Superior Court by two property owners against the Bridgeport Hydraulic Co. and the state health commissioner. The plaintiffs seek a declaratory judgment establishing their rights to the use of water passing over their properties.

The property owners assert that they have a vested right equal to that of other riparian owners on the streams concerned and that the right can only be taken away from them by purchase. They assert that the statute under which the health commissioner is empowered to prohibit swimming in streams tributary to reservoirs is an improper exercise of the police power.

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Court Action Sought On Jamaica Bay Dumping

Decision has been reserved by the Brooklyn Supreme Court in a taxpayers suit seeking a temporary injunction to restrain the city of New York and William F. Carey, commissioner of sanitation, from proceeding with plans to dump refuse on islands in Jamaica Bay. The application for the injunction was made by a resident of Brooklyn, which borders on the Jamaica Bay waterfront, and is the outcome of opposition expressed by local civic groups toward the proposed plan. Details of the dumping plan have not yet been made public.

The injunction application also seeks to restrain the city from proceeding with a contract to purchase 30 steel scows for hauling the refuse, on which bids were opened last week.

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Dravo Protest Holds Up Garbage Scow Award

Contract awards for 30 steel scows to be used by the New York City department of sanitation have been held up pending the outcome of protests filed with the city and with PWA by the Dravo Co. of Pittsburgh.

Bids for the scows were called on a design developed by the department or on a suitable alternate design by the bidder. Dravo, in submitting its own design, bid $1,393,000. The lowest bid on the city design was $1,485,000, made by the Brewer Drydock Co.

The city, which is receiving a federal grant of $450,000 for the scows, has asked PWA to approve the Brewer bid.

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Town Asks Damages For Pollution

The city attorney of Shawnee, Okla. has been instructed to file claim against Oklahoma City asking damages of $2,500,000 for pollution of the North Canadian River, formerly Shawnee's water source. Shawnee will contend that pollution of the stream by sewage from Oklahoma City forced Shawnee to go to great expense to obtain a new source of water from wells and a recently completed lake.

District to Pay Half On Reclamation Job

Half cost of Colorado-Big Thompson project charged to power

A contract between the Department of the Interior and the Northern Colorado Water Conservancy District for repayment of that portion of the cost of the Colorado-Big Thompson federal reclamation project allocated to irrigation, was executed July 28. It provides that the conservancy district repay half the cost of all work involved in the construction of the project, except that the district's maximum obligation is placed at $25,000,000. The estimated cost of the project is $44,000,000.

The other half of the cost will be charged to power and repaid from power revenues.

The district agrees to pay half of the operating and maintenance costs of all project works except those pertaining exclusively to power.

The contract was recently approved by vote of about 18 to 1 by the electorate of the conservancy district.

Other features of the contract include a provision that the district compensate Grand County over a period of time for tax losses amounting to $100,000. Grand County, on the western slope, is not in the district.

The United States will operate and maintain the project indefinitely, and the district is required to set up a reserve to aid in making repairs and replacements. Title to all work remains in the United States and the power revenues accrue to the United States.

The Colorado-Big Thompson project for diversion of water from the west to the east slope, includes a 13-mile tunnel under the Continental Divide, the Green Mountain reservoir and power plant on the western slope, five power plants and transmission lines, and storage reservoirs and distribution systems on the eastern slope.

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Sale of Utility to TVA Approved by FPC

Sale of the Tennessee Public Service Co. electric facilities to the city of Knoxville, the TVA, and the Appalachian Electric Power Co. at a total purchase price of $9,333,000 has been approved by the Federal Power Commission.

The commission found that under the proposed plan electricity rates in the city can be reduced 33 to 47 per cent and still produce sufficient revenue to cover operation, maintenance and depreciation.

Lilienthal Gives Details Of Sabotage Charges

Morgan asserts misleading cost estimates were called for by counsel during litigation on TVA constitutionality

Charges made by David E. Lilienthal that Arthur A. Morgan had tried to sabotage the TVA's case in the injunction suit brought against the agency by 18 power companies were aired last week in testimony before the congressional committee investigating TVA. Also under discussion were counter charges by Morgan that James L. Fly, general counsel for the TVA, had asked TVA engineers to prepare misleading cost estimates for use at the trial.

Lilienthal had previously told the committee that Morgan was "tampering" with witnesses, was trying to "sabotage" the TVA's case, and was "seeking to bring about a decision against his own agency."

The only testimony on this last point was given by John Lord O'Brian, special TVA counsel, who said Morgan had inquired of him whether it were not possible that the decision might sustain the constitutionality of some of the TVA functions, and reject others. Lord was more worried, however, he told the committee, by Morgan's insistance that some of his engineers were "embarrassed" by testimony they were being urged by TVA lawyers to give at the trial. He dwelt at length on the impression made on him and on Fly by having such a reflection made on their integrity on the eve of the trial when they were undergoing great strain.

This was the basis, it developed in later testimony by Lilienthal and Fly, of the charge that Morgan was "tampering" with witnesses.

Morgan told the committee that an engineer under him, E. Lawrence Chandler, had been asked by Fly to prepare estimates of the cost of a single purpose series of dams, for flood control, and then another set of dams for navigation. Then Chandler was told by Fly to add these two estimates together, and to subtract the total from the actual cost of the projects.

Morgan had taken the view that this was willful misinterpretation—was presenting an impossible situation, and could be designed only to deceive the court and tremendously minimize the cost to the government of the power produced in the projects.

"We want to win lawsuits," he told the committee, "but we want to win them honestly."

He was also afraid, he testified, that such testimony before the court would discredit his engineers before their profession and before the country.

Both O'Brian and Fly testified that the estimates were only sought against the possibility that the power company attorneys would produce certain lines of attack. Actually, O'Brian and Fly pointed out, the evidence was never used.

Later the committee heard six of the engineers in question. Two of them agreed with Morgan's fears, they said, and four thought them unjustified. All the four used the expression that the estimates would not be misleading unless "willfully misinterpreted."

Carl A. Bock was the strongest defender of Morgan on this. It was he who had first been alarmed by Chandler's concern over being asked for the estimates. His concern grew when Chandler told him that he had suggested to Fly that he propose a dual purpose estimate, allowing for flood control and navigation but not for power. Chandler said Fly had not wanted that. So Bock went to Morgan, and the "tampering" with witnesses began.

Bock told the investigating committee that these estimates were based "on an impossible premise," that they "minimized the cost of power," and that they contained a "semblance of allocation of costs" as between power, navigation and flood control.

Harry Wiersema, another of the engineers, testified that he felt he had been "under pressure."

Robert A. Monroe, another engineer, told of some changes which he had obtained which made the estimates "less capable of willful misinterpretation."

Fly insisted to the committee that everybody understood the estimates were purely theoretical, and insisted no intelligent child would be misled by them.

Several committee members, including Senator Lynn Frazier and Representative Charles A. Wolverton—there were only four present out of ten on the day this occurred—had expressed impatience with the barrage of "charges and counter charges" with which the committee has been cluttering up its record.

Nature of yardstick

Representative Wolverton, who has been conducting most of the cross examination during the Knoxville hearings, started the yardstick discussion by asking Lilienthal what were the elements which made it possible for TVA to produce current more cheaply than privately owned plants.

Difference in the interest rate, Lilienthal promptly replied, was the chief advantage of a government owned enterprise. The government, he said, could borrow money at less than two per cent. A privately owned corporation would have to pay a great deal more.

"This advantage is inherent in government operation," said Lilienthal, "and the people are entitled to get electricity at the lowest possible cost."

Lilienthal frankly admitted, on questions from Wolverton, that federal taxes were another advantage which a project like TVA has over private corporations.

"Another advantage," continued Lilienthal, "is that the government can incorporate in one project several objectives, such as navigation and flood control, etc."

"When a private corporation constructs a dam for power purposes," pressed Wolverton, "does not that dam have an effect on navigation and flood control."

Lilienthal shrugged.

It was at this point that Senator Schwartz intervened, and wanted to know what became of the yardstick aspect if such elements were considered.

Lilienthal gave the committee the second big surprise of the day. He asked for time to prepare an answer. It was a complicated question he said, and he wished to study over it, write it carefully, and then polish it up before submitting it. He wanted no careless words to appear in it, he said, which might be subject to criticism. The committee agreed to wait for this definition.

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Pennsylvania Department To Study Silicosis

As the first step in a comprehensive investigation of the silicosis hazard in the state, the Pennsylvania department of health has initiated a study of health conditions among employees in a number of silica brick plants. It is planned to examine this summer 2,000 to 3,000 employees in the industry and thus determine the incidence of silicosis.

Attention will be paid to the length of time the workers have been engaged in handling silica products, and the processes used at the different plants will be compared. The department hopes thus to determine the least amount of silica dust that can cause silicosis and will also attempt to determine what operations in the brick making are most hazardous.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

INTERNATIONAL CONGRESS FOR INDUSTRIAL ACCIDENTS AND OCCUPATIONAL DISEASES, Frankfort-on-the-Main, Germany, Sept. 26-30.

AMERICAN PUBLIC WORKS ASSOCIATION, annual meeting, New York City, Oct. 3-5.

NATIONAL SAFETY COUNCIL, annual congress, Stevens Hotel, Chicago, Oct. 10-14.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, French Lick Springs, Ind., Oct. 10-14.

NATIONAL RECLAMATION ASSOCIATION, annual meeting, Reno, Nev., Oct. 11-13.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Rochester, N. Y., Oct. 12-14.

LOCAL AND REGIONAL

WESTERN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Reno, Nev., Aug. 10–13.

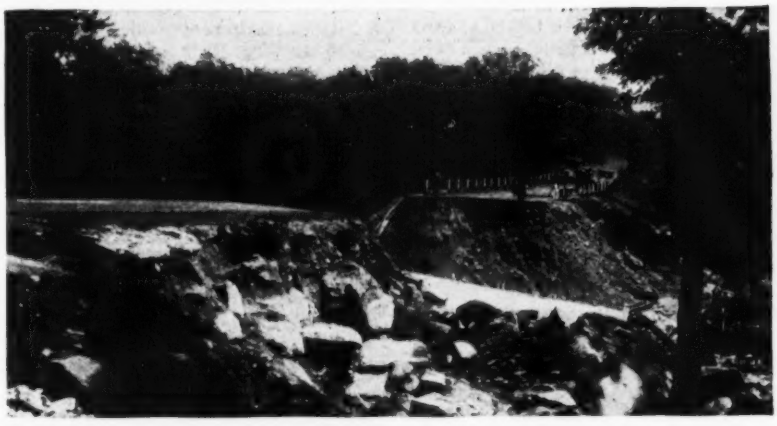
AMERICAN WATER WORKS ASSOCIATION, local section meetings scheduled: Central States, Wheeling, Aug. 17-19. New York, Poughkeepsie, Sept. 22-23. Wisconsin, Milwaukee, Oct. 10-12.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Hotel Statler, Boston, Sept. 13-16.

ELECTIONS AND ACTIVITIES

THE MOLES, newly-organized association of men actively or formerly engaged in tunneling, sewer, subaqueous, subway, or foundation work, will come above ground for their first big outing and clam bake to be held at Karatsonyi's on Long Island Aug. 24. Alex Stagg, secretary, 143 Ocean Ave., Jersey City, N. J., has all the particulars.

SEVERAL state highway officials who attended the International Road Congress at the Hague and who inspected the highway systems of Germany, England, France and Italy have agreed to present their observations and conclusions at the annual meeting of the Association of State Highway Officials to be held in Dallas December 5, 6, 7 and 8. Among those who will appear in that symposium are: Thomas H. MacDonald, chief of the Bureau of Public Roads; R. E. Toms, chief of the division of design of the roads bureau; H. G. Shirley, chairman of the Virginia Highway Commission; Murray D. Van Wagner, of the Michigan Highway Commission; and T. H. Cutler of the Kentucky Commission.



HEAVY RAINS BREACH DAM AND ROAD FILL

PARTIAL FAILURE of the Killingworth Dam of Guilford-Chester Water Co. of Clinton, Conn., on July 23 (*ENR* July 28, 1938, p. 101) resulted in the loss of a high fill east of Killingworth on Route 80, Connecticut's new highway parallel to U. S. Route 1 east of New Haven. Here shown (*top*) is the section of the dam that was overtopped and partly washed out. Erosion cut away support for the corewall east of the spillway, and a section about 100 ft. long overturned. Part of the stored water was saved by building a temporary dam of sandbags and earth. Below is shown the highway fill a few hundred yards below the dam behind which the water ponded until the fill was overtopped. A 10 x 10 concrete box culvert through the fill overturned.

State Building Code Urged By Washington Labor

Passage next year of legislation establishing a state-wide building code for the state of Washington and a state building department to administer it will be sought by the Washington State Federation of Labor according to a decision at its recent convention.

Intended to bring the standards of construction throughout the state up to those prevailing in the major cities, the proposal calls for preparation of a building code by a committee composed of three licensed engineers, three licensed architects, and three representatives of labor. A state building inspector would be appointed in each county, working under the direction of the proposed department, who would issue building permits, approve plans, and make final inspections.

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Consultants Are Engaged On Washington Bridge

The Washington State Toll Bridge Authority has retained the New York City firm of Moran, Proctor & Freeman as consulting engineers for the $6,000,000 Narrows Bridge near Tacoma, Wash. The authority has obtained a PWA grant for the project and is now seeking a PWA load for the balance.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

PLANS for installation of power units at Fort Peck Dam on the Missouri River in Montana, are being formulated. Water wheels for two 35,000-kw. generators will be built below Tunnel No. 1. Contract for installation and supply of this power equipment will probably be let early next year.

A TENDENCY is developing to shift away from the calendar year in the handling of registration of motor vehicles. Returns to the Bureau of Public Roads show that twelve states already have adopted a different basis and others are considering a change. It has been found that licenses are renewed more promptly at periods other than the end of the year.

ELIMINATION of 3,014 grade crossings and the installation of standard signals at 2,114 other crossings of railway and highway, has resulted in the five years since federal money became available for that purpose. In addition 438 structures separating grades have been reconstructed.

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South Penn Turnpike Gets Big Grant

(*Continued from page* 125)

which is to be repaid from tolls, have not yet been determined.

Although the new agreement between PWA and RFC is flexible in nature and cannot be expressed in fixed rules, it is expected that it will function chiefly on large undertakings of a self-liquidating nature. PWA, as formerly, will provide a 45 per cent grant, while a 55 per cent loan will be supplied from the ample coffers of RFC. Only a comparatively small number of projects, it is expected, will utilize the new plan, since most municipalities now find it more economical to finance their loans through private sources.

RFC financing

It is expected that RFC will be called on only in those cases in which bonds to be financed from project revenues form the loan security; this type of obligation is generally less attractive to the private investor than the usual general obligation municipal bond. In addition to the South Penn Turnpike, several other large projects are under consideration, including a $35,000,000 subway in the Chicago Loop and the proposed $70,000,000 tunnel connecting the Battery on Manhattan Island with Brooklyn.

It is impossible to estimate the effect that the new plan will have on the volume of non-federal construction; except that by relieving the PWA funds from certain heavy drafts for loans, it may defer exhaustion of the $965,000,000 voted by Congress for the 1938 PWA program. Should PWA have a substantial amount of money not applied for on the Sept. 30 deadline, the effect would be slight; if, however, there should be more requests than can be met, the new plan would result in the acceptance of a number of additional projects.

First contracts let

First actual construction contracts under the 1938 PWA program are now being let, in connection with the federal portion of the program.

The Coast Guard is the first federal agency to begin construction. Under a $10,000,000 allotment, the Coast Guard is awarding contract for 550 buildings. Within three weeks after it received its allotment, 237 contracts have been or are ready to be let. In addition, 35 large contracts involving $4,052,000 are in preparation.

OBITUARY

HERMAN VALENTINE, bridge designer in the office of the city engineer of Los Angeles, died July 24. He had served in the city engineer's office for 15 years.

CLEMENT E. WEARY, maintenance engineer of the Los Angeles County road department, died June 14, aged 49. Maintenance engineer for the past eleven years, Weary had been with the road department since 1914.

FRANK D. FENHAGEN, 47, Baltimore consulting engineer, died there July 28. Fenhagen was a graduate of the University of Pennsylvania.

ARTHUR BARRE, for the past 25 years waterworks engineer at Hull, Quebec, died July 27 at the age of 61.

HARRY C. CROWELL, assistant to the chief engineer of the Pennsylvania R.R. in the New York zone, died July 29 in New York City at the age of 55. A graduate of Massachusetts Institute of Technology in 1903, Crowell joined the engineering staff of the Pennsylvania in that year. From 1912 to 1916 he was engineer of track elevation at Chicago and for the next four years was principal assistant engineer in Pittsburgh. He assumed his New York post in 1920.

Bids Received on Section Of Delaware Aqueduct

Low bid on Contract 306 of New York City's Delaware Aqueduct was offered July 22 by Associated Contractors, Inc., bidding $21,333,333.33.

Contract 306 covers the bypass tunnel under Kensico Reservoir. It will extend 3,500 ft. from south of shaft 19 to north of shaft 17, both of which shafts have been completed by Dravo Contracting Corp. The down-take at shaft 17 and the up-take at shaft 18 will be deepened by the tunnel contractor.

Associated Contractors is a syndicate composed of H. J. Kaiser, J. F. Shea, and Walsh Construction Co. Second bidder was Rosoff Construction Co. at $22,707,000, and the high bidder was Kensico Tunnel Corp., bidding $24,652,300.

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Wilder Heads Public Works In San Francisco

A. D. Wilder has been appointed director of the San Francisco department of public works, succeeding William H. Worden, who is retiring to give more time to personal business.

Wilder has been executive engineer of the San Francisco housing authority. He was formerly state WPA director.

After graduating from the University of California in 1908, Wilder spent three years in railroad work and then became a member of the staff of the Panama Pacific Exposition, first as assistant civil engineer and later as assistant structural engineer in charge of building construction. He was engaged for fifteen years in water power and railroad construction work in this country and Canada, and in 1930 he began to practice privately in San Francisco.

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Duncan Made City Engineer In Baltimore

Frank K. Duncan, assistant chief engineer of Baltimore since 1925, has been appointed chief engineer to fill the vacancy caused by the death of Bernard L. Crozier.

Duncan has been associated with the municipal government of Baltimore most of the time since 1894, when he became a draftsman in the topographical survey. He entered the office of the city engineer in 1900, transferring to the paving commission in 1911. He resigned from that department in 1921 to enter the contracting business, but returned to the municipal service two years later as assistant highway engineer.

PERSONAL

JAMES ADAMS, instructor in engineering at the University of Alberta, recently retired from the teaching staff.

FRANK M. ROSS, engineer and vice-president of the Hamilton Bridge Co., Ltd., Hamilton, Ont., has been chosen chairman of the board of directors.

SULTAN G. COHEN, chief engineer of construction of the Indiana state highway commission, has resigned in order to re-enter private business.

CLIFTON J. BRADY has resigned as engineer plan examiner in charge of Washington state architectural projects for the PWA. He will become a partner of F. A. Naramore, architect of Seattle, Wash.

JACOB L. CRANE, city planning consultant, has been appointed assistant administrator of the U. S. Housing Authority. Crane has been consultant to regional planning commissions in Wisconsin, Illinois and Michigan.

B. J. KNUDSEN has been appointed city engineer of Bessemer, Mich.

COMNDR. ROBERT E. THOMAS of the Navy civil engineer corps has been appointed to succeed Capt. E. R. Gayler as public works officer at the Puget Sound Navy Yard effective Oct. 1. Capt. Gayler is retiring from the service. Comndr. Thomas, in the Navy since 1917, has been public works officer in the Panama Canal Zone and most recently has been at the Bureau of Yards and Docks at Washington.

KENNETH A. GODWIN has been made regional director of PWA in region No. 6, which includes Arizona, California, Nevada and Utah.

CHARLES H. FENNELL has been appointed executive director of the Los Angeles Housing Authority, now being organized. Fennell, a structural engineer, has directed the building of many large industrial plants, including most recently the $12,000,000 Chrysler plant in Los Angeles.

WALTER W. ALLEY, since 1934 technical director of the Los Angeles Municipal Housing Commission, has been appointed to the same position under the new housing authority.

RALPH A. O'ROURKE, formerly field engineer for the WPA in Colorado, Wyoming and New Mexico, has been appointed chief engineer of the regional WPA office in Salt Lake City.

CLARENCE W. DUNHAM, engineer in the design division of the Port of New York Authority, has been made instructor in architectural construction at the Cooper Union Art School. Dunham has been engaged on bridge and tunnel projects of the Port of New York Authority for ten years. Earlier he taught at Rensselaer Polytechnic Institute, of which he is a graduate, class of 1920. Before joining the authority, he was assistant chief draftsman in the bridge division of the Bethlehem Steel Co.

HAROLD F. ZUMSTEIN has been appointed to the newly created position of traffic engineer of Detroit. He was formerly metropolitan engineer for the Michigan State Highway Department.

FREDERICK M. FEIKER, executive secretary of the American Engineering Council, has received the honorary degree of Doctor of Engineering from Worcester Polytechnic Institute.

LABOR NOTES

SUSPENSION of the collective labor agreement in the Montreal construction industry on building repairs costing less than $2,000 (*ENR*, July 14, 1938, p. 40), has already resulted in wage cuts ranging up to 35 per cent, according to reports to the Montreal Trades and Labor Council. Painters have been particularly hard hit, since most repair work includes painting. Plumbers and steamfitters have experienced difficulty in distinguishing between repair work and new work in their trades.

A RATE of 70 cents an hour for hod carriers was accepted in principle in the settlement of a strike called on a high school project at Tulsa, Okla., by the International Hod Carriers Building and Common Laborers Union (ENR, July 21, 1938, p. 70). The settlement provides that the rate for common labor be raised from 40 to 50 cents, that the rate for hod carriers on all future jobs be raised from 40 to 70 cents, and that on the present job hod carrying work be done by common labor at the common labor rate.

• • •

New Series of Reports Begun by Bureau

In connection with its current program of investigation of materials and structures for use in low-cost housing, the National Bureau of Standards has begun publication of a new series of reports intended to make the results of their investigations more readily available. The first report, PMS-1, described objectives of the study.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN JULY, 1938

Engineering News-Record *reports projects of the following minimum costs; Waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States July 1938	United States Seven Months 1938	United States Seven Months 1937	Canada
Waterworks	142	354	22	732	379	525	**2,154**	49,845	46,610	97
Sewerage	282	3,721	70	2,259	289	586	**7,207**	59,663	57,134	241
Bridges, public	313	5,154	1,070	315	2,663	645	**10,160**	50,779	74,664	686
Earthwork and waterways	481	679	204	2,467	4,019	40,799	**48,649**	165,026	55,730	2,763
Streets and roads	896	8,599	10,811	15,555	19,757	12,574	**68,192**	340,099	233,480	1,351
Buildings, public	3,395	3,782	1,343	1,795	1,826	2,414	**14,555**	184,059	197,693	635
Unclassified, public	398	9,952	814	4,025	2,390	4,271	**21,850**	90,726	96,679	916
Total public	**5,907**	**32,241**	**14,334**	**27,148**	**31,323**	**61,814**	**172,767**	**940,197**	**761,990**	**6,689**
Federal government (included in above classifications)	636	1,453	1,256	3,622	1,654	46,608	**55,229**	175,150	114,538	.....
Private										
Bridges, private	.....	.....	.....	60	25	125	**210**	4,548	5,651	.....
Buildings, industrial	235	3,453	295	532	1,170	882	**6,567**	95,501	337,204	1,650
Buildings, commercial	2,200	24,827	250	4,485	736	4,797	**37,295**	383,190	285,869	1,355
Unclassified, private	175	2,984	322	700	523	1,790	**6,494**	54,828	114,715	370
Total private	**2,610**	**31,264**	**867**	**5,777**	**2,454**	**7,594**	**50,566**	**538,067**	**743,439**	**3,375**
Total Engineering Construction										
July, 1938 (4 weeks)	**8,517**	**63,505**	**15,201**	**32,925**	**33,777**	**69,408**	**223,333**	.....	.....	**10,064**
June, 1938 (5 weeks)	9,226	67,429	26,079	30,586	46,457	43,289	**223,066**	.....	.....	12,614
July, 1937 (5 weeks)	11,280	108,398	30,397	49,285	36,352	24,289	**260,001**	.....	.....	11,214
Seven months — 1938	63,922	602,446	138,979	183,469	248,012	241,436	.....	1,478,264	.....	51,011
Seven months — 1937	70,627	709,701	141,061	233,305	205,468	145,267	.....	.....	1,505,429	72,791

CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	July 1937*	July 1938	% Change	Seven Months 1937	Seven Months 1938	% Change
Total Construction Volume	$260,001	$223,333	+7.0	$1,505,429	$1,478,264	−2.0
Private	103,181	50,566	−39.0	743,439	538,067	−28.0
Public	156,820	172,767	+38.0	761,990	940,197	+24.0
Federal	21,885	55,229	+216.0	114,538	175,150	+53.0
Total New Productive Capital	$319,744	$1,417,950	+454.0	$917,817	$2,487,402	+171.0
Private Investment	149,967	53,263	−56.0	675,786	583,160	−14.0
Federal (non-Federal work)	169,720	350,092	+159.0	241,974	754,062	+212.0
Federal (Federal work)	57	1,014,595	+	57	1,150,180	+
FHA Mortgages Selected for Appraisal	$47,152	‡88,266†	+87	$381,331	$542,775†	+42

* *Five-week month.* † *Preliminary total*

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	August 1937	August 1938	% Change	Change July to August 1937 July	1937 Aug.	%	1938 July	1938 Aug.	%
ENR Construction Cost Index, 1913 = 100	240.65	232.39	−3.5	239.90	240.65	+0.3	232.29	232.39	0
ENR Building Cost Index, 1913 = 100	200.65	194.49	−3.2	199.80	200.65	+0.4	194.39	194.49	+0.1
ENR 20-CITIES' AVERAGE									
Common Labor	$0.668	$0.677	+1.4	$0.662	$0.668	+0.9	$0.677	$0.677	0
Skilled Labor (Av. 3 trades)	1.369	1.426	+4.2	1.348	1.369	+1.6	1.426	1.426	0
Bricklayers	1.459	1.519	+4.1	1.441	1.459	+1.2	1.519	1.519	0
Struct. Ironworkers	1.413	1.473	+4.3	1.381	1.413	+2.3	1.473	1.473	0
Carpenters	1.235	1.288	+4.3	1.221	1.235	+1.1	1.288	1.288	0
Cement, per bbl.	$2.54	$2.58	+1.6	$2.53	$2.54	+0.4	$2.55	$2.58	+1.2
Reinforcing Steel, Pittsburgh	2.55	2.05	−19.6	2.55	2.55	0	2.05	2.05	0
Structural Steel, Pittsburgh	2.25	2.10	−6.7	2.25	2.25	0	2.10	2.10	0
Sand, per ton	1.16	1.24	+6.9	1.17	1.16	−0.9	1.25	1.24	−0.8
Lumber, 2x4 Fir, per M ft	37.42	31.24	−16.6	37.90	37.42	−1.3	31.32	31.24	−0.3
Lumber, 2x4 Pine, per M ft	32.84	27.88	−15.1	33.15	32.84	−0.9	27.62	27.88	+0.9
Brick, common, per M	14.27	13.86	−2.9	14.24	14.27	+0.2	13.79	13.86	+0.5
Ready-mixed Concrete, c.y.	7.37	7.14	−3.1	7.32	7.37	+0.7	7.20	7.14	−0.8
Struct. Clay Tile, 3x12x12	72.85	74.24	+2.1	74.05	72.85	−1.2	74.32	74.24	−0.1
Paving Asphalt, cars, ton	17.31	15.38	−11.2	17.32	17.31	−0.1	15.64	15.38	−1.7

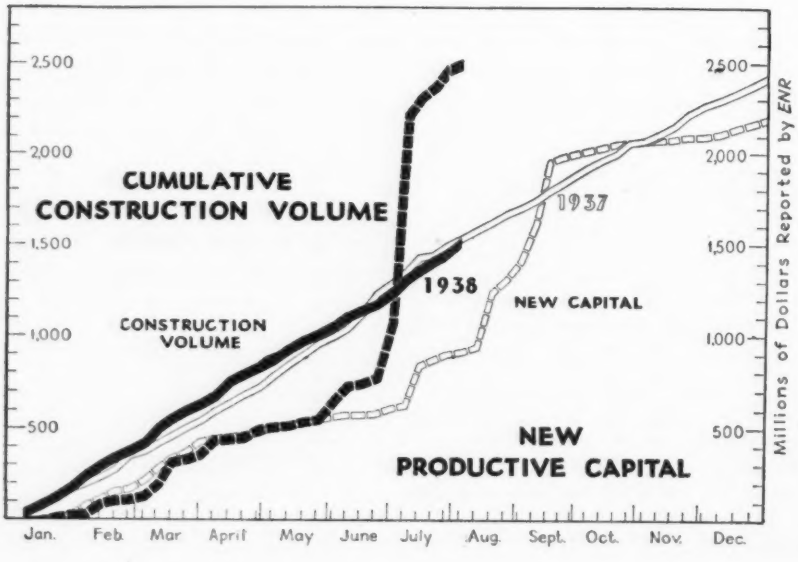
MATERIAL SHIPMENTS . . . BUILDING PERMITS

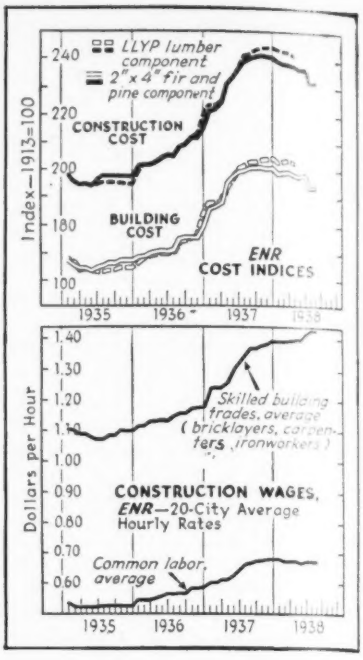
	July 1937	July 1938	% Change	June 1938	% Change June-July
Lumber (% 1929 wk. av.) NLMA	72.4	55.5	−23.2	55.0	+0.9
Steel (% operating capacity) AISI	79.2	32.0	−59.6	27.5	+16.3

	June 1937	June 1938	% Change	Six Months 1937	Six Months 1938	% Change
Fabricated Struct. Steel (AISC) tons	147,618	93,393	−36.7	780,056	560,074	−28.1
Cement, thous. bbl. (USB of M)	12,645	10,932	−13.6	52,538	45,586	−13.1
Building Permits, Dun & Bradstreet (,000 omitted)	$94,753	$87,626	−7.5	$586,183	$527,551	−10.0

RENT INDEX . . . EMPLOYMENT

	June 1937	June 1938	% Change	May 1938	% Change May-June
Rent (Housing) Index, NICB	86.6	86.7	+0.1	87.0	−0.3
Trade Unions, % Employed, AFL	89.0	81.0	−9.0	81.0	0
Building Trades, % Employed, AFL	79.0	64.0	−19.0	63.0	+1.6





THIS WEEK'S FIGURES

(Thousands of dollars)

CONTRACTS

	Week Ending Aug. 5 1937	July 28 1938	Aug. 4 1938
Federal	$6,749	$2,897	$14,864
State & Municipal	21,783	32,264	31,113
Total public	$28,532	$35,161	$45,977
Total private	15,509	13,555	11,477
TOTALS	$44,041	$48,716	$57,454
Cumulative 1938	(31 weeks)		$1,535,718
1937	(31 weeks)		$1,549,470

Note: Minimum size project included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 31 Wk.	1938 31 Wk.
NON-FEDERAL	$931,399	$1,365,403
State & Mun. bonds	350,868	392,383
Corporate securities	338,557	201,226
PWA loans, grants	12,035	339,246
RFC loans	29,939	64,891
U.S.H.A. loans	....	154,528
R.E.A. loans	....	11,629
Federal Aid-Highways	200,000	201,500
FEDERAL	$57	$1,150,180
TOTAL CAPITAL	$931,456	$2,515,583

ENR INDEX NUMBERS

	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Base = 100						
Aug. 1938	232.39	111.71	194.49	105.14	...	...
July 1938	232.29	111.66	194.39	105.08	207	91
June 1938	236.86	113.86	198.22	107.15	166	73
Aug. 1937	240.65	115.65	200.65	108.55	152	67
July 1937	239.90	115.10	199.80	108.00	187	82
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

More or Less?

Sir: Some months ago you had several testimonials in regard to field notes on land tracts. After a recent happening in our office, we think we are entitled to a front row seat on the mourners bench.

An oil operator came in the office and asked if we would prepare him a plat of an area if he would supply us with the field notes, taken from the land owners deeds, to which we agreed. We are giving below the description to one of these tracts:

"*SIXTH TRACT:* 100 acres, more or less, out of a 425 acres tract out of the Sion Pritchard Survey situated about 7 miles N. 45 E. from Jacksboro on the West Fork of the Trinity River, which Richard Ray sold to H. B. Lewis by deed dated Oct. 27, 1896, the 100 acres being the unsold portion of said 425 acres which still remained in said H. B. Lewis and that portion thereof which is located in the S. E. corner of said Sion Pritchard Survey and which lies south and west of the Jacksboro and Cundiff road nearly as it runs, said land is enclosed with a wire fence except on the river. Being bounded on the north and northeast by said river and on the east, southeast, south and southwest by the original boundary line of said Sion Pritchard survey and on the west and northwest by said Jacksboro and Cundiff road, said *above description may not be exactly correct but is mainly and generally accurate.*" (Italics by the editor.)

Will you ask some good surveyor to come down and draw this tract on the map for us?

TERRILL ISBELL
Consulting Engineer
Jacksboro, Tex., July 18, 1938

Plywood Gusset Plates

Sir: There are errors in the article on Plywood for Gusset Plates published in the June 23 issue, p. 881, which should be recorded.

The name of the first author is H. N. Benkert, not Beckert.

In Fig. 1, the location of the first slip is not indicated. It is at the first major break in the curve.

In the table on p. 882 the initial slip at zero load for the beveled ring in fir lumber should be negative; the figures should read —.006 and —.004.

With reference to Fig. 2, where both types of connector have been shown, it should be noted that in tests the two connectors used in any one assembly were of the same type, not different as here shown.

F. J. HANRAHAN
Washington, D. C., June 30, 1938

Everyday Concrete

Sir: Your editorial, July 14, 1938, on the report of Miles N. Clair, on the compressive strength of everyday concrete is very timely. Mr. Clair's statement that he found concrete strength on the average job from somewhat less than ½ of the expected strength to 60 per cent more than that showed that his business was with contractors who were familiar with concrete work.

But what is expected strength? If he meant the strength taken from the data freely supplied by trade organizations or the reports of our engineering colleges, which engineers not familiar with the checks and adverse chances of the ordinary contracting business often mean, then I believe that he encountered average workmanship that does not benefit from expert engineering supervision. Only a few months ago I heard that 1:1:2 column concrete placed by a reputable contractor using modern tested cement showed 28-day cylinder strength of less than 1700 lb. per sq.in. or less than one-third of laboratory strength.

The 1936 regulations of the American Concrete Institute, which have been adopted or taken as guide for the new codes for New York, Chicago and other large cities, have reduced the factor of safety formerly in use, namely, 4 to 6, to about 2½ to 3 now, which in view of the revelation of Mr. Clair seems to constitute a grave error.

It is a fact that neither code makers nor structural engineers do better work on the average than the concrete contractor whose cylinders once in a while test up to ½ of the expected concrete strength.

I quite agree with you that concrete research to date appears to have done little to improve everyday practice in concrete design and construction.

L. J. MENSCH
General Contractor
Chicago, July 19, 1938

Sir: That editorial "Everyday Concrete" on page 43 of the July 14 issue carries a mighty appeal to me, because I have to make a lot of that kind. I have been hunting everywhere for testing equipment, and it isn't to be had at prices I can afford; $6.00 for a slump cone, $16.00 for a measure with 0.5 cu.ft. capacity; $3.00 to $4.00 for a rod to tamp materials in the measure and around $25.00 for scales to measure out materials for test purposes.

And then when I make an attempt to investigate the different methods of computing proportions there is such a luxuriant forest of these that the way is not simply obscure but completely obliterated. No wonder the everyday workman just ignores the whole business and mixes his mud "by jedgement".

We need simplified methods and equipment for handling these simplified methods of testing that can be bought within the range of the cost of the usual journeyman's tools. Until such methods and tools are developed "everyday concrete" is going to be mighty poor stuff.

The fine results that can be achieved by laboratory methods in the institutions that can afford thousands of dollars for such equipment will never become generally applicable until the journeyman can obtain and use methods and tools he can understand—and also afford to carry in his tool kit.

It is up to the leaders of the concrete industry to thin out a lot of heavy undergrowth that has sprung up in their neck of the woods. When this has been done the rest of us will be able to see and utilize the sound timber we understand is growing there, but that we are unable to reach and use.

R. F. MIRICK
Construction Engineer
Killdeer, N. Dak.

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

AUGUST 4, 1938

PRESIDENT RIGGS' frank recognition of the changed status of the American Society of Civil Engineers in his address to the Salt Lake City convention is a healthy sign, coming as it does from one of the older men who might be expected to cling firmly to the long cherished idea that the Founder Societies are technical bodies which cannot concern themselves with such matters as pay rates, working conditions and unemployment. Dr. Riggs noted that the society has been increasingly active in non-technical affairs in a sporadic manner since 1930 and declared that though such activities are repugnant to some members the society must plan to do more of such work than it has in the past if present conditions persist. It was the dire condition of many of its members that projected the society into welfare work in 1930. The society stepped in to fill a gap that no other organization was then able to fill, and it stands to the credit of men like Arthur Tuttle, the late Harrison P. Eddy and George Seabury that in order to meet the emergency they put aside any scruples they had concerning the society's right to take up such work. If the society is to continue to be of maximum service to its members it must, as Dr. Riggs states, organize to carry on these activities as long as required.

Looking Ahead

BUT DR. RIGGS was less realistic when he came to discuss the continuation of the societies' welfare and professional work. He spoke as one unaware of the fact that there are such organizations as the American Association of Engineers or the state societies of professional engineers with their recently formed national society. The sole objective of these organizations is professional advancement of the engineer. The National Society of Professional Engineers did not exist in 1930 and the A.A.E. lacked financial strength and organized national leadership to meet the emergency of that year. Had either been strong there would have been no need for the Civil Engineers to step out of the part as a technical society. Conditions are changed today, though neither of the younger organizations is in a position to take over entire responsibility for all matters of professional welfare. Nevertheless the civil society might properly plan its activities on the assumption that the day will come when there will be strong and closely integrated state professional societies rather than endeavor to get the other Founder Societies to join with it in further development of professional activities through local sections, as Dr. Riggs proposed. We need strong state societies of professional engineers. The Founder Societies should work to strengthen the state groups rather than to weaken them by attempting to occupy the field that they have chosen to develop.

Timber Framing Progress

MILEPOSTS in the progress of design are likely to be set up by events that focus attention on certain problems. In building the 1915 exposition at San Francisco timber was used to a very large extent in the great armory-like palaces, and it became necessary to go beyond rule-of-thumb methods of design. Literature on framed timber was meager; hence where doubt existed tests were made. Bolted timber joints were given their proper strength rating, and a substantial advance in framed timber design was made by thorough development of wood-pin joints. The book "Timber Framing", written as a byproduct of this work by H. D. Dewell, who had much to do with the design of the 1915 buildings, set a milestone in the progress of timber design. Preparations for the coming Golden Gate exposition are again bringing substantial engineering advance, as illustrated by the strap-and-pin joint described by John J. Gould in this issue. Ring connectors, developed since the 1915 exposition, made the new joint possible, and thus helped to create what promises to be another major improvement in timber design.

New Ideas Still Pay

DOING THINGS in the conventional way, following precedent, imitating past practice, is proper if no better way can be devised. But almost daily little improvements in construction methods are turning out to be big improvements in making the job safer, more efficient, more profitable. Three jobs described in this issue in addition to the timber joint just mentioned incorporate new ideas that attest to this fact. For example: (1) To speed up work on P.R.R. grade crossings, the contractor made three simple-span plate-girders into a single erection piece by temporary splices. (2) To establish uniform tension in a group of hanger rods supporting steel arch centering on a concrete arch bridge in Binghamton, N.Y., strain gages were used; this method was more accurate, more efficient and almost as easy as striking the rods with a hammer and comparing the rings. (3) To line a shield-driven tunnel on Staten Island, precast tongue-and-grooved concrete blocks were developed which require no pointing of joints

or inner lining; a speedy, low-cost installation is claimed to have been the result. Construction advances by virtue of such displays of ingenuity. New ideas still pay.

RFC Backs the PWA

COOPERATION between the Reconstruction Finance Corporation and the Public Works Administration, as just announced, will theoretically enable the PWA to expand its activities to nearly twice the amount originally planned. How much actual expansion will result is doubtful in view of the fact that of $618,000,000 so far alloted only $37,000,000 has been in the form of loans. Cities are raising their 55 per cent of the cost through normal financing. Under the circumstances it appears logical to expect that RFC loans will be made only for projects like the Harrisburg-Pittsburgh highway, tentatively approved for a combined RFC loan and PWA grant totaling $58,000,000, or for the Battery-Brooklyn vehicle tunnel at New York—large projects of questionable earning power, for which local bodies find it difficult to raise funds through banks or public sale of securities. How such large projects can be completed by the date set in the act, June 30, 1940, is not clear.

Water and Flood Control

ENACTMENT of the new flood-control law by Congress six weeks ago initiates a fundamental change in government's relation to rivers, and is likely to involve river control and development in a cloud of uncertainties, both legal and political. The federal government through this act confirms and extends the claim to full control of all rivers in the United States that it first made with the 1936 act. If this claim is acquiesced in by the states through tacit acceptance, long-standing rights and jurisdictions will be altered.

No constitutional warrant for federal flood control has heretofore been recognized. Federal authority over streams has been grounded on the right to control navigation facilities by virtue of the interstate commerce clause, and the scope of river and harbor work has been defined and limited accordingly. More than 35 years ago the Reclamation Act carefully considered state rights over streams and directed that all federal work be done under state laws. The Water Power Act of a dozen years later, though badly strained by recent ambitions of the Power Commission, recognizes federal authority over power structures only where they affect navigation. And even within the past three years the Supreme Court, in upholding the Tennessee Valley Act, referred specifically to the federal right to improve navigation.

The new Flood Control Act, departing from this precedent, asserts the federal government's right to undertake flood-control work on any river without regard to navigation effects and to take ownership and control of both the water and the power. Not even incidental recognition of any rights and powers of states is included in the act. It appears to tie the states' hands completely in everything that relates to streams large and small.

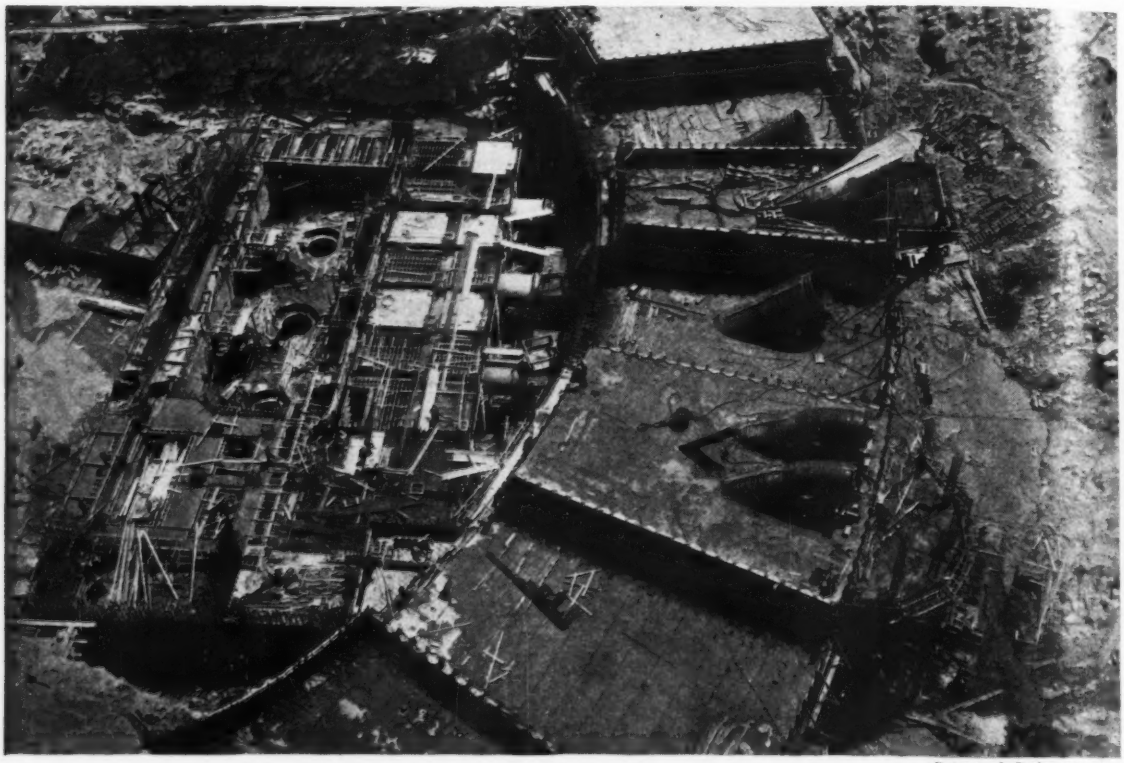
In the dispute between the New England states and the federal government for flood control on the Merrimack and Connecticut rivers, the contention of the states that power and water rights are reserved to them is denied by the new act through its specific provisions for the purchase of reservoir lands by the United States and control of power by the Federal Water Power Commission. Whether the government would undertake to enter Vermont or New Hampshire territory and buy reservoir lands and build dams for the protection of cities in Massachusetts and Connecticut, and whether in so doing it would acquire lawful control of the water and power resources of such storage, is a question to be answered in the future. But even the assertion of federal authority through the new act creates a shadow-zone of control over rivers that will tend to paralyze any constructive action against floods by either state or nation.

Strong emphasis is laid on the intent of the government to control all waters by the provision of the act which authorizes the Department of Agriculture to plan and construct works for water control and soil erosion. In its ultimate application this provision places every drop of water from the point of original rainfall to its discharge into the sea under the sole control of the Washington authorities. If anything further were needed to express the intent of the present administration in this respect, it would be found in the President's memorandum approving the act, which expressed reluctance to sign because of insufficient provision for centralized federal planning—clear reflection of a purpose to achieve complete federalization of all our waters.

For immediate purposes the act means that henceforth no community or local government will do anything whatever about floods. It will not try to do the job that Uncle Sam has said is his own, but will wait for him to do it. The opportunity and indeed incentive thus given for political logrolling is unmistakable.

In view of the radical departure which the new act makes from all previously recognized water authority and policy, and the practical questions that surround its application, it may be expected that the act will not long remain unchanged. While it stands on the statute books, however, it will probably operate to check rather than to promote flood-protection work. Both its uncertainties and its effects make it desirable that an early challenge of its essential assertion of federal power be sought.

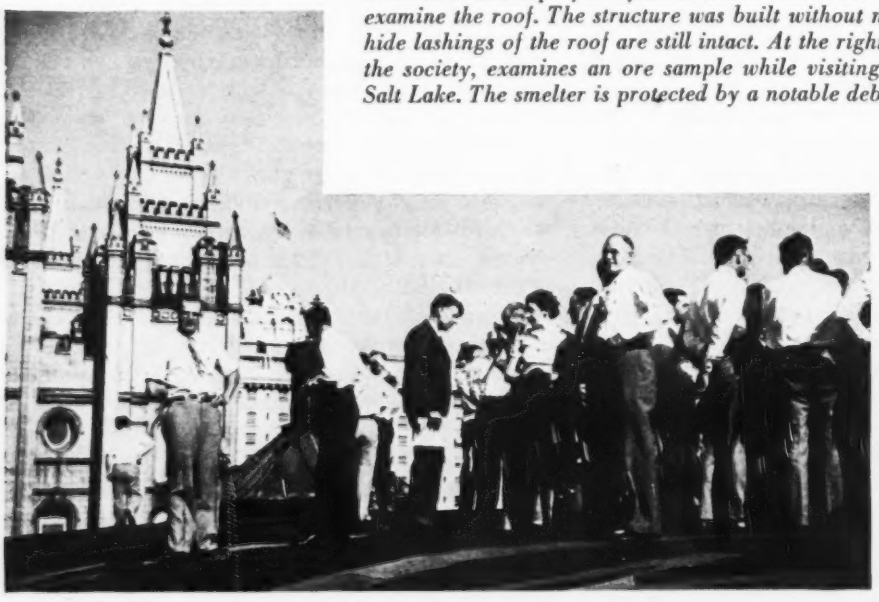
PICTURES IN THE NEWS



Bureau of Reclamation Photo

SEMINOE DAM in Wyoming is now 35 per cent complete. Set in the concrete block in the center foreground are two 72-in. outlet pipes; beyond are the three 120-in. penstocks which pass down through the dam into the powerhouse at the left. The substructure of the powerhouse is 75 per cent complete.

ENGINEERS, meeting at Salt Lake City for the summer convention of the American Society of Civil Engineers, climbed to the top of the famous Mormon Tabernacle to see the city and to examine the roof. The structure was built without nails and the original rawhide lashings of the roof are still intact. At the right, Otis Hovey, treasurer of the society, examines an ore sample while visiting one of the smelters near Salt Lake. The smelter is protected by a notable debris basin.



Photos by C. G. Grove

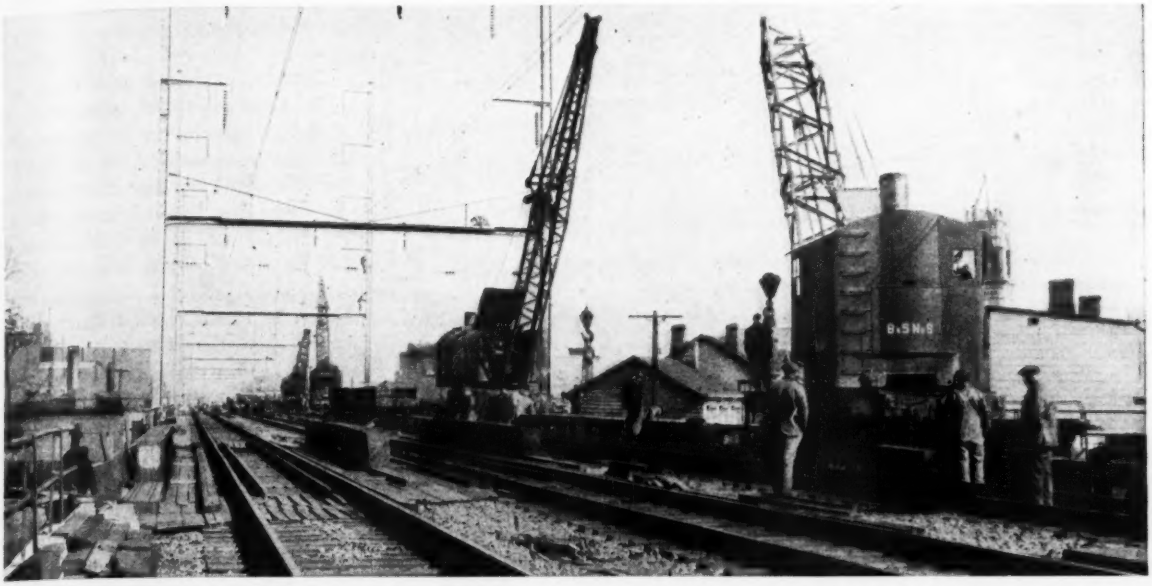


FIG. I. LOCOMOTIVE CRANES CHANGE BRIDGE STEEL ONE TRACK AT A TIME ON BUSY RAILROAD

Bridge Replacement Under Busy Tracks

Steelwork of five four-track Pennsylvania R. R. structures at New Brunswick, N. J., rebuilt under heavy traffic by well-coordinated operations

REPLACEMENT of five four-track open-deck bridges with new steelwork and waterproofed concrete decks under high-speed traffic of 300 trains a day was a difficult job just completed by Senior & Palmer, Inc., for the Pennsylvania R.R. at New Brunswick, N. J. Through careful preparations and a well-coordinated schedule of operations the work was completed without slowing down any of the trains, some of which run at very high speed over this stretch of track. The longest any of the four tracks was out of service was 8 hr., and the worst operating condition lasted only 1 hr. 40 min., when two tracks were killed. Though slow orders were not tolerated and as many as 300 men were working on the tracks at one time, no injury due to trains occurred throughout the eight months of operation.

The four-track, electrified line of the railroad has been elevated through New Brunswick for many years. All masonry for the bridges over the streets and the heavy retaining walls is of cut stone; all of the bridge superstructures are steel. Power for electric operation is supplied through catenary wires.

The structures are five consecutive bridges at Handy, Townsend, Suydam, Bayard and Patterson Streets, built in 1902 when the railroad was elevated through the city. The first two structures are single spans from abutment to abutment; the last three are three-span bridges with curb columns and pony spans over the sidewalks. Two of the bridges are on a 40 deg. skew.

All of the old bridges were five-girder structures with open decks, the three center girders being common to two tracks. The floor system consisted of transverse beams 12 ft. c. to c. carrying track stringers framed between the cross beams. The new structures are likewise of five girders, with floorbeams 2 ft. c. to c. carrying a concrete ballast deck and concrete haunches that extend up the sides of the girders. Haunches and deck are protected by membrane waterproofing, with copper flashing at the top of haunches. A typical cross-section of a deck is shown in Fig. 2.

Preparations

New concrete bridge seats and column pedestals, and new steel columns were placed in the bridges by the same contractor under a previous contract two years ago. The first step in preparation for the superstructure changes was to raise the tracks from 9 to 15 in. by ballasting, to provide room for the new ballasted decks. This, in turn, required raising the height of the retaining walls by a concrete cap to accommodate the new depth of ballast. The raised tracks were temporarily carried over the old bridges on longitudinal timbers resting on the track stringers and over the backwalls on longitudinal steel beams

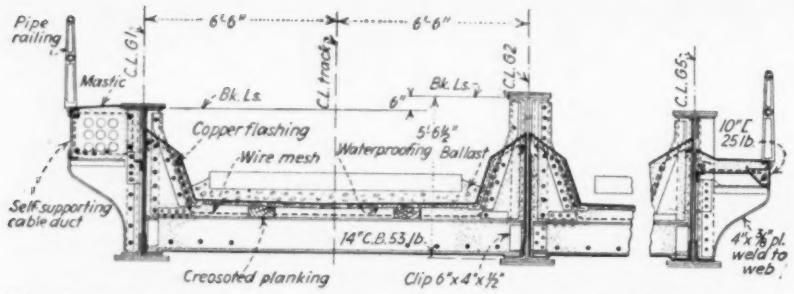


Fig. 2. Typical cross-section of one of the five bridges, built under high speed traffic by virtue of well-planned operations.

that were later embedded in the new backwall concrete.

Elaborate and detailed plans for every move were worked out in advance by the contractor and railroad officials. The operating department agreed to release one track at a time for not more than 8 hr.; and an adjoining track for a limited time during the same period, a schedule upon which all operations were based. To illustrate the extent of detailed advance planning, the following is quoted from official railroad orders covering operations for one day, Jan. 18, 1938:

Will require the use of No. 1 track for a period of about eight hr. after train No. 28, due at Canal at 9:20 a.m. and clearing for train No. 142, due at Canal at 5:24 p.m., for the installation of girders on the south and north sides of No. 1 track and the erection of floorbeams between the girders. In addition, it will be necessary to have the exclusive use of No. 2 track for three hours from 10:30 a.m. until 1:30 p.m. during the removal of the old bridge steel and the placing of the new girders.

Two engines with engine and train crews will be required to report to Mile Run Yard not later than 8:30 a.m., and make up to equipment previously prepared. Both engines to be headed east.

The first train will proceed on No. 1 track after passage of train No. 28 with four cranes and four idlers, two drop-end gondolas and one flat car, and twin-load containing two new steel girders for Handy Street, engines to be on west end of trains. It will set off one crane and idler on east side of Townsend Street, one crane and idler on west side of Townsend Street, one crane and idler on east side of Handy Street, and the remaining crane and idlers on west side of Handy Street. The engine and remaining cars will then return to Canal to follow the second train east on No. 2 track to Handy Street. The second train will proceed east to Townsend Street on No. 2 track at 10:30 a.m., with two empty drop-end gondolas separated by an idler, and twin-load containing two new steel girders for Townsend Street; engine to be on west end.

Upon arrival of trains, the cranes will remove old bridge steel and load in empty gondolas. The cars of new girders will then be spotted so that girders can be set in place by cranes, after which both trains will proceed to Mile Run Yard and store cars, clearing No. 2 track, one engine and crew to be released. The remaining engine and crew will return to No. 1 track, to pick up cranes and idlers as soon as floor system installation is completed, and return them to Mile Run Yard clearing No. 1 track.

Power will be removed from tracks No. 1 and No. 2 during the periods when tracks are out of service.

A large crew of flagmen provided protection for the workmen, giving warning of approach of trains by whistles and waving targets to designate the track to be cleared. Visibility to the east was limited by a curve, which added to the hazard from fast trains. During the periods that tracks were out of service a train dispatcher at the site took absolute control of all train movements over the section.

Just as soon as a track was taken out of service power in the overhead lines was cut off and the catenaries were pulled to one side by a special crew to permit operation of locomotive cranes on the track.

Steel replacement

The general plan of replacement of the steel work contemplated working on one track at a time, cutting the floorbeams to permit lifting the old girders with part of the attached floor system, and then setting the new girders and floorbeams. All of the steelwork was replaced before any of the concrete decking was poured. This plan required two more items of preparation: the placing of falsework under the two center tracks at all bridges; and the temporary splicing of both old and new three-span girders to permit handling of the full length span in one lift.

The falsework under tracks 2 and 3 was extremely heavy, consisting of double bents of four well-braced 12x12-in. posts for each track, with 12x12-in. caps and sills. Spanning between bents were four longitudinal I-beams that carried the floor system of the bridges. For the three-span bridges five sets of bents were required; three sets served each of the single spans. The falsework was arranged to permit keeping the streets open to traffic, except during actual shifting of the steelwork.

One more precaution before starting the steel changing was to unload a set of new girders in the nearby railroad yards and hold a complete rehearsal of the shift schedule.

The diagrams in Fig. 3 show the successive steps in replacing the steel. On the first set of operations two adjacent bridges were worked simultaneously, using two independent crews. The operations went so smoothly that the remaining three bridges were worked together, using three crews. Minimum and maximum periods of time each track was out of service are indicated on the sketches. Contractor and railroad officials alike are proud of the speed in which the operations were carried out. Though one track was available for 8 hr. and the adjoining track for 2 hr. for each major operation, only in one instance did it take the full allotted time.

View I in Fig. 3 shows a typical bridge ready for the change, with the track blocked up on timbers to meet the raised grade, and falsework in place under tracks 2 and 3. View II shows the first step. Track 1 was available for 8 hr.; track 2, for 2 hr. As soon as the catenary wires were pulled clear, two locomotive cranes with 50-ft. booms were brought in on track 1 for each of the two bridges, a crane being spotted at each end of each bridge. The trackwork was removed first by railroad maintenance gangs. Then the floor beams were cut midway between girders 1 and 2, and again between girders 2 and 3, close to girder 2.

Work trains with a string of empty gondolas and loads of new steel moved in on track 2. Working together, the two cranes at each bridge lifted old girder 1, then girder 2, into the empty cars. Then the train was shifted to bring the loaded cars within reach of the cranes, and new girders 1 and 2, without any of the

floor system attached, were quickly unloaded and set. Track 2 was now released for traffic.

To expedite the release of track 2, the contractor had trucked all of the floorbeams for the track 1 bridge to the street below. Then, without swinging and thus fouling the adjacent track, the cranes picked up the beams from below with low booms. As fast as the beams were hoisted they were bolted into place along with the girder kneebraces.

Looking ahead to concrete deck placement, the authorities placed creosoted timber planks longitudinally under the rails, the planks being cut to the exact thickness of the concrete above the top of the beams. The planks were left in place permanently and eliminated the troublesome job of later digging track supports out of the concrete. Timbers the height of future ballast were placed over the planking, and the track restored, completing the first operation (View III).

Track 2 was the next to be handled, being available for 8 hr., and track 3 was killed for 2 hr. After removal of trackwork on track 2, the floor girders of track 3 were cut close to girder 3 (View III). Girder 3 was then lifted off, the floor system and temporary falsework stringers loaded, and new girder 3 set in place. Floorbeams were lifted from street level and bolted into place. Setting of the creosoted planking and blocking timbers and restoring the track completed operation No. 2.

The next operation (View IV) was to replace track 4 in the same manner as track 1, cutting the floorbeams between girders 4 and 5, and between 3 and 4 close to girder 4. The completion of this operation (View V) left track 3 supported entirely on falsework. However, the floor system and track were well blocked to the new girders. In setting girders 4 and 5, template struts were placed under track 3 to assure exact spacing of the steel.

The final operation was to pull out the track and floor system of track 3 and place the new floorbeams. Connecting angles were loose on the beams to permit easy erection.

Exactly the same procedure was followed in replacing steel on the next three bridges, worked together. After setting of the floorbeams in track 3 of this last set of bridges, the tracks were not killed again except

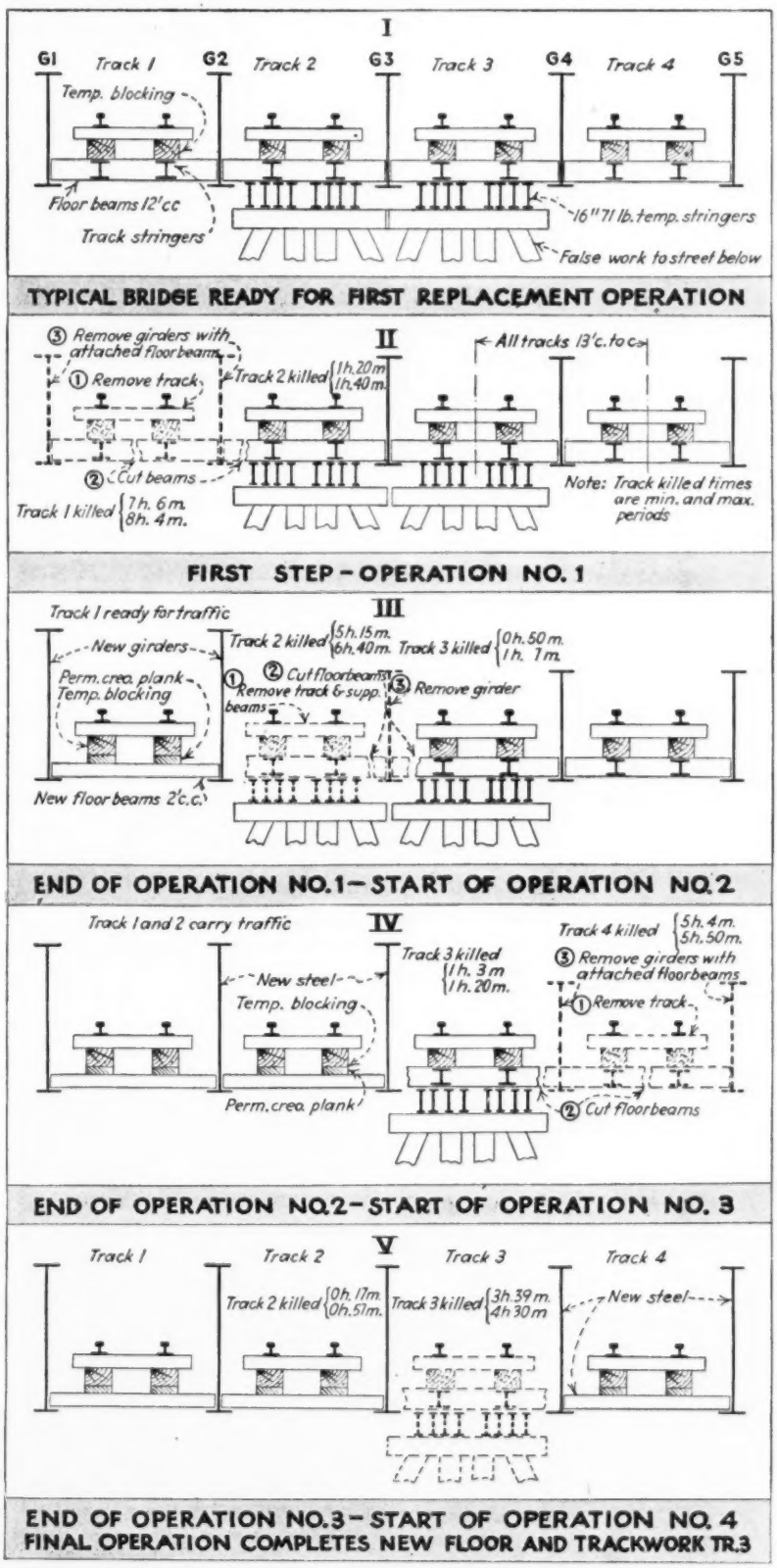

I
G1
Track 1
G2
Track 2
G3
Track 3
G4
Track 4
G5
Temp. blocking
Floor beams 12'cc
Track stringers
16" 71 lb. temp. stringers
False work to street below
TYPICAL BRIDGE READY FOR FIRST REPLACEMENT OPERATION
II
③ Remove girders with attached floorbeams
① Remove track
② Cut beams
Track 1 killed {7h. 6m. 8h. 4m.
Track 2 killed {1h. 20m. 1h. 40m.
All tracks 13'c. to c.
Note: Track killed times are min. and max. periods
FIRST STEP - OPERATION NO. 1
III
Track 1 ready for traffic
New girders
Perm. creo. plank
Temp. blocking
New floor beams 2'c.c.
Track 2 killed {5h. 15m. 6h. 40m.
Track 3 killed {0h. 50m. 1h. 7m.
① Remove track & supp. beams
② Cut floorbeams
③ Remove girder
END OF OPERATION NO. 1 - START OF OPERATION NO. 2
IV
Track 1 and 2 carry traffic
New steel
Temp. blocking
Perm. creo. plank
Track 3 killed {1h. 3m. 1h. 20m.
Track 4 killed {5h. 4m. 5h. 50m.
③ Remove girders with attached floorbeams
① Remove track
② Cut floorbeams
END OF OPERATION NO. 2 - START OF OPERATION NO. 3
V
Track 1
Track 2
Track 3
Track 4
Track 2 killed {0h. 17m. 0h. 51m.
Track 3 killed {3h. 39m. 4h. 30m.
New steel
END OF OPERATION NO. 3 - START OF OPERATION NO. 4
FINAL OPERATION COMPLETES NEW FLOOR AND TRACKWORK TR. 3

Fig. 3. Diagrammatic sketch of the various operations in removing the old bridges and erecting the new steel. The notations indicate the periods of time each track was out of service.

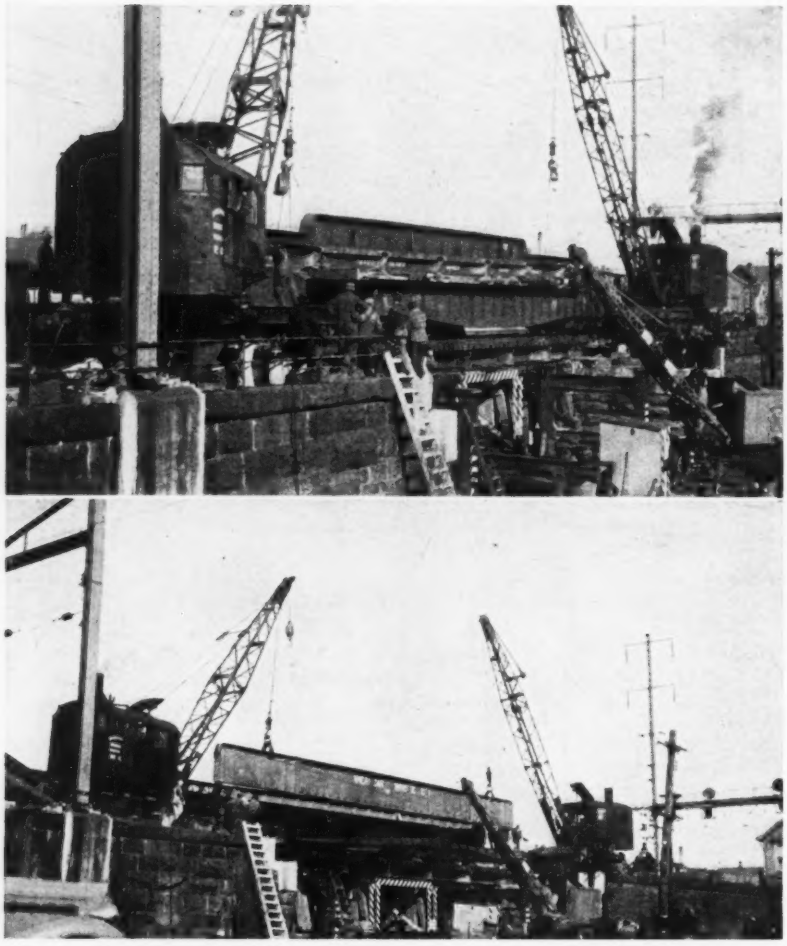


Fig. 4. Two cranes working together lift off the old girders (above) and set the new steel in place (below). Corresponding track structures on two adjacent bridges were worked simultaneously on the first moves; the remaining three bridges on the second set of operations.

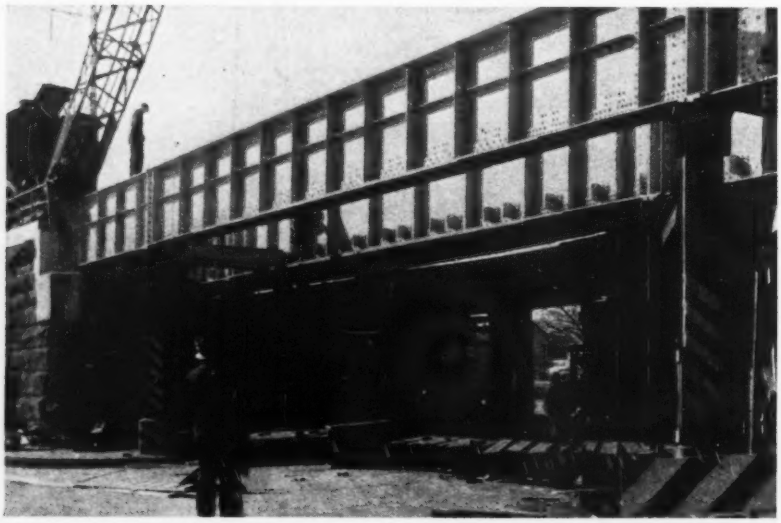


Fig. 5. Two new girders ready for floorbeams which were hoisted from the street. Note the temporary girder splices over the columns to permit hoisting the three spans as a unit.

for placement of the deck waterproofing and ballast. Riveting of the steelwork, building of forms, placing of concrete, and waterproofing the haunches were all done under traffic operating at full speed.

Concreting under traffic

As the concrete deck came flush with the bottom of the lower flanges of the floorbeams, the deck formwork was simple, consisting of panels hung from the top flanges. Forms for the haunches were wood panels set just outside the ends of the ties. Concreting operations were scheduled for one track on one bridge per day.

Concrete was mixed at street level and hoisted by a crane, also kept at street level, to a hopper on top of the retaining wall. From the hopper the mix was distributed to the forms by buggies and wheelbarrows over plank runways (Fig. 6). All concrete was vibrated internally. Concrete crews were protected at all times by a large force of flagmen.

Waterproofing and ballasting

The membrane waterproofing was placed on the haunches without disturbing the track or interrupting traffic. As the membrane was cut to lap at the center of the track, the layers for the inaccessible areas were dry lapped and rolled up under the ends of the ties.

Placing of the center waterproofing and ballasting of the decks were done in one general operation. This work was carried on simultaneously over all five bridges, one track at a time. Each track, in turn, was out of service from 7 to 8 hr. Track gangs, supplementing the contractor's forces, first removed the old track and temporary supporting timbers. The concrete deck was then swept clean and high spots chipped off. Waterproofing was then applied in three layers and a protection of 1¼ in. asphalt planking was laid over the waterproofing. The planking was previously cut to pattern and each piece marked to speed up actual placing. Good weather prevailed throughout the waterproofing, except the last day on the last track, when a sudden shower interfered. The deck was hurriedly dried by mops and compressed air jets to permit completion of the job.

Following the waterproofers, the track gang placed 4-in. filler strips to carry the new track during ballasting operations. As soon as the track was laid, a ballast train moved in from each end. The log for track 2 for these operations is typical of all four tracks:

9:30-10:30 a.m., remove rail, ties and timber; 10:30-1 p.m., apply waterproofing; 1-2:30 p.m., place filler strips and new track; 2:30-4:30 p.m., drag ballast and surface track.

Railroad forces took care of the catenary wires, track and signal removal and replacement, and the ballasting. They also provided temporary platforms for passenger and baggage service at the New Brunswick and Stelton stations when certain tracks were killed.

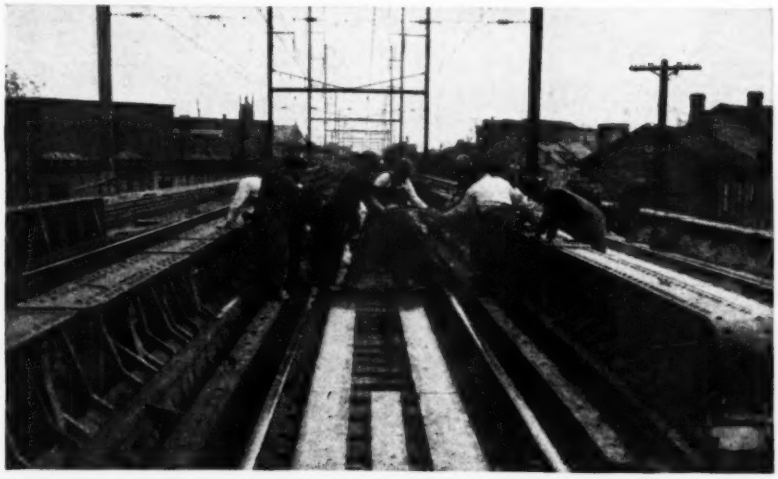


Fig. 6. Concreting on the run. All slab and haunch concrete was placed without interference with 300 high-speed train movements a day.

Direction

Because of the necessity of close cooperation between the contractor and operating officials, the contract was let by the division operating department. For the Pennsylvania Railroad the following were in charge: D. Y. Geddes, superintendent, New York division; R. R. Nace, chief engineer of maintenance of way, New York zone; R. H. Crew and J. M. Fox, division engineers, and B. F. Stidfole, supervisor of bridges and buildings. Design of the new bridges was under the direction of T. W. Pinard, engineer of bridges and buildings, New York zone.

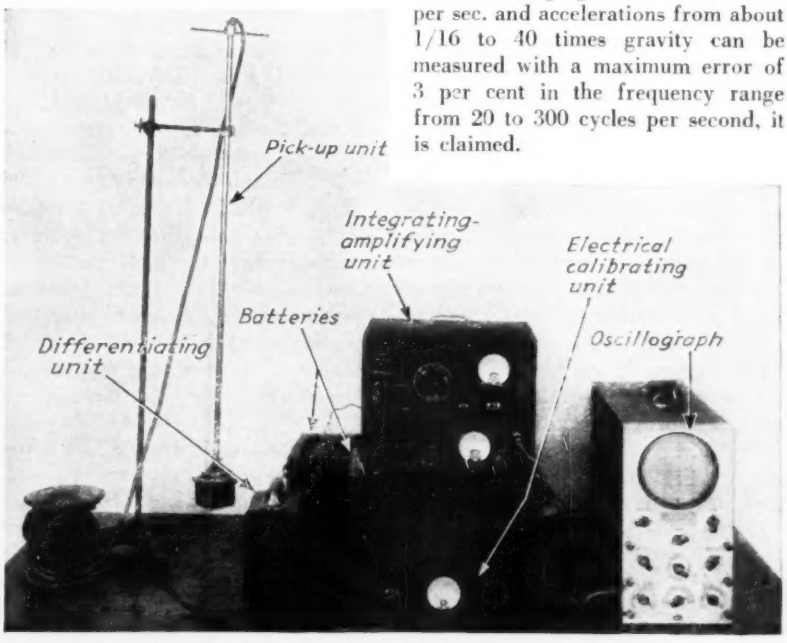
For the contractor, Senior & Palmer, Inc., of New York City, J. F. Armstrong was superintendent and H. C. Booz, field engineer. The steel was fabricated by the American Bridge Co.

Measuring Concrete Vibrations

AN APPARATUS has been developed by the National Bureau of Standards which measures the particle displacements, velocities and accelerations set up by a vibrator inserted into a concrete mass. Described in detail in a paper by George L. Pigman, F. B. Hornibrook and J. S. Rogers in the May, 1938 *Journal of Research* of the Bureau, the apparatus is held to be helpful in evaluating such factors as type, size and operating frequency of vibrators, rigidity of forms, presence of reinforcement, and the use of different mixes and cement-water ratios in their relation to the effectiveness of vibration and to the propagation of the vibrations through the concrete.

The apparatus includes a small electromagnetic pickup unit which is immersed with definite orientation, in the concrete and, following the motion of the surrounding concrete during vibration, produces an alternating voltage which at any instant is proportional to the velocity of the concrete motion in a given direction. This alternating voltage is carried through a vacuum tube amplifier to a cathode ray oscillograph where the operating frequency and the velocity may be measured and the velocity wave form observed. The corresponding displacement and acceleration waves are obtained on the oscillograph screen by the use of integrating and differentiating circuits, respectively. By switching from one circuit to another, the wave forms and the magnitudes of the particle displacement, velocity and acceleration may all be obtained using the one pickup unit.

Amplitudes of steady vibration ranging from 0.00035 to 0.045 in., velocities ranging from 0.01 to 2.5 ft. per sec. and accelerations from about 1/16 to 40 times gravity can be measured with a maximum error of 3 per cent in the frequency range from 20 to 300 cycles per second, it is claimed.



Assembly of vibrograph instruments used in measuring concrete vibrator action

FIG. 1. EXTREME IRREGULARITY OF STREET PATTERN IS ONE OF THE MAJOR PROBLEMS OF CORPUS CHRISTI

Growth Problems in Corpus Christi

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How a city engineer in one of our fastest growing cities keeps service facilities abreast of requirements despite handicaps of an unknown future development

When a city jumps in population from 28,000 to 60,000 within seven years its municipal services are likely to find themselves unduly overloaded, inadequate and sorely pressed. Water supply will soon prove deficient, the distribution pipes too small and pressures low, so that insurance rates climb. Sewers become overloaded until heavy storms flood the drainage system.

If to such man-made features is added a complicated layout due to a location on an irregular waterfront along a great expanse of shallow bay into which pours a large muddy river, as at Corpus Christi, Tex., and also an immense background of 125 oil fields within 150 mi. radius from the city which bring in their product through 24 lines of pipe for rail and water distribution, the problems facing the municipal engineering officials become prodigious. For good measure include a rich agricultural area of cattle and cotton, and do not omit the natural mineral resources which contribute to growth via the processing route.

Corpus Christi is one of the fastest growing cities in the country. A visiting engineer finds matters of absorbing interest in the problems resulting from the conditions just indicated, and in the way they are being met. At least that was my experience in going over the city recently with J. C. Bisset, city engineer. Construction reports had given me news of several new projects under way, but no hint of how many more are needed or how far growth has outstripped facilities.

On a visit a dozen years ago, the dock and turning basin development had just been completed, under C. J. Howard, city engineer of that day and resident engineer for R. J. Cummins. The shipping was yet to come, however. Now it is here—with 5,500,000 tons of freight going in and out last year, not counting the tonnage from oil docks at Ingleside and Port Aransas on the same channel. In the five months of the current year the tonnage topped ½ million tons each month. A federal appropriation is being sought to double the turning basin size. An oil tanker was just loading for Europe; two others, disappointed in obtaining cargo in Mexico, had stopped here for cargo. Cotton warehouses line the docks, and even though the export business has been slackening cotton is going abroad.

This was all new. So was the business of the alkali works bringing brine from a salt dome 65 mi. away

through an unlined cast-iron pipe (a civil engineering problem of no mean proportions for maintenance after construction. An equal if not greater problem is in the making in a 15-mi. fresh-water main laid partly through salt marsh).

Land connections

Back-country agricultural development has kept pace with industry and furnishes its quota of interchange freight, congesting the highways with city-bound products crossing the oil-well machinery and supplies rushing outward to the oil fields. State and county have met this demand with a radial network of paved highways.

Interesting as is this country development (and it is primarily in the engineer's province), the present article has mainly to record the city's problems. However, one link should not pass unnoted. One of the main entrances to Corpus Christi by road and railroad is over a causeway and a narrow bascule bridge that must be operated for every vessel passing to the turning basin. The daily traffic varies from 4,500 to 25,000 vehicles and a bridge opening of 20 min. will back up street traffic a mile or more. Boats enter and leave via the 22-mi. ship channel to Aransas Pass early in the morning and just before sunset, when people are going to and from work, which accentuates the congestion.

Some 3,978 bridge openings in 1937 well define the congestion. The situation has led to serious study of a wider double bascule or a tunnel under the channel. But the entrance problem also is tied up with a beach boulevard proposal which would provide a second crossing connecting two wide thoroughfares skirting the waterfront along the business center.

A few of the services which the engineers have recently added in the rush to keep facilities abreast of the needs include a 4-m.g.d. sewage treatment plant, two 120-ton garbage incinerators, increased water supply through an added 30-in. cement-lined cast-iron conduit 16 miles long, a new 10-m.g. covered reservoir, a 15-mi. extension of the distribution system tying in dead ends and providing new subdivisions with service, and repair of the existing 22 mi. of pavements (nothing has been done about the 116 mi. of dedicated but unpaved streets within the city limits beyond macadamizing with shell). Yet during the doubling of population within 7 years the engineers succeeded in operating the outgrown facilities effectively enough to maintain service and prevent breakdowns.

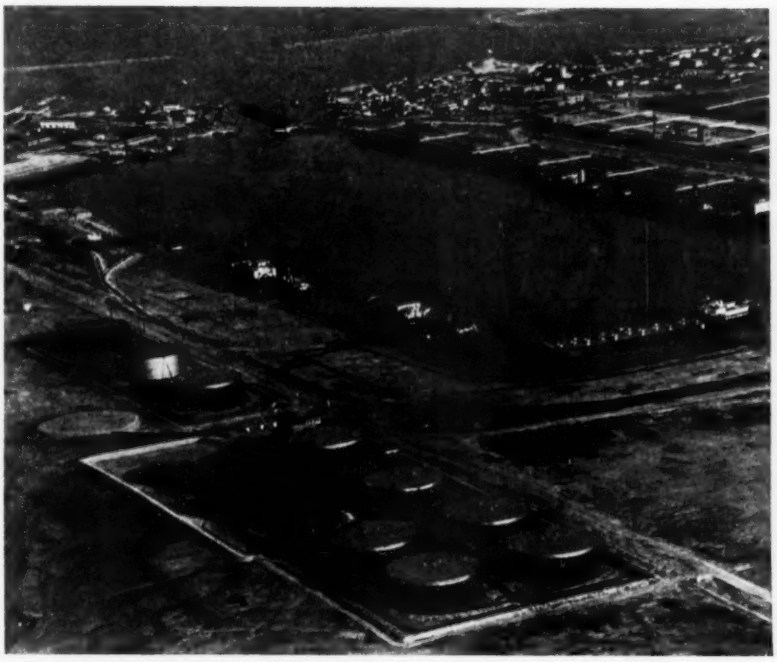


Fig. 2. In 7 years the Corpus Christi port has developed 5,500,000 tons of cargo and is largely responsible for doubling the size of the city. Seventy vessels per month seek cargo here, largely oil via 24 pipelines from 7,000 wells in 125 fields within a 150-mile radius.

Problems of sewerage

A treatment plant completed a year ago and still in the tuning-up period, designed by Harrington & Cortelyou, handles strong sewage of 350 to 400 B.O.D. As the sewers have extremely flat grades (6-in. lines, 0.5 per cent; 8-in., 0.3 per cent; 12-in., 0.3 per cent), the sewage is often septic by the time it reaches the plant. A flushing schedule constantly brings in quantities of partly digested sludge. Odors at the plant are kept down by the addition of 450 lb. of chlorine, which shows no residual by the time the sewage passes the pumps and reaches the two clarifiers (which were designed for 3-hr. detention but due to overload can retain the sewage only half this period). The 55-ft. clarifiers, which discharge to four 160-ft. trickling filters containing 6½ ft. of rock, are supplied by distributors turning at 34 r.p.m.

This plant was designed to be good until 1945, but because of the rapid city growth it is already taxed near to capacity; means for increasing the capacity and effectiveness of certain units of the plant are being considered.

From the clarifiers the sludge is pumped to the digesters for 45 to 60 days. Some 7,200 gal. of sludge is drawn off twice a month to drying beds covering an acre. The 50-ft. digesters, are covered with a 4-in. concrete roof having radial ribs and cross purlins. About 50 yd. of gravel on top, graded in thickness from 18 in. at the periphery to 8 in. in the center, prevents the gas pressure from lifting the roof.

The sewer system does not collect all the sewage; its flow, 3½ to 4 m.g.d. bears little relation to the water consumption (about 6 m.g.d.). Though an ordinance requires residents to connect their premises with the sewers when a line is within 200 ft., many houses in the outskirts use cesspools, which operate satisfactorily for 2 or 3 years, especially in the bluff area which is 25 to 40 ft. above gulf level.

Despite the great deficiency and overloading of sanitary sewers and storm drains, money is not available to provide the necessary trunks and interceptors. What an adequate sys-

tem will cost has not been determined. As the area is flat—the 38-ft. contour crosses Morgan St., running east and west, six times in 2½ miles—heavy rains lead to serious ponding.

What has been said of the inadequacy of the sewer system is true in another way of the water distribution system. Many of the mains laid by subdividers for domestic use are of 2-in. size. Except for the two supply conduits from up-river—the old 20-in. and new 30-in. line—distribution is by 4, 6, 8 and 10-in. mains. Last season $134,000 was spent on eliminating dead ends and bringing a third 10-in. main into the business district along the waterfront. In all some 15 mi. of pipe were laid. But the engineers believe that scientific study of the system by the Hardy Cross method and a block-by-block estimate of demand are essential for maintaining a favorable Underwriters' rating, which now is on a 25c. credit basis. Efficient fire department service is no small factor in holding this rating.

The new 30-in. line, designed by Myers, Noyes & Forrest in conjunction with the city engineer, was completed in May. Its use permits a shutdown of the two boosters on the existing 20-in. main, in which velocities up to 7 ft. per sec. have been recorded. Last summer the pen on the recording chart of the venturi meter at the filter plant traced a non-fluctuating straight line, indicating a constant pumpage of 5.3 m.g.d.; in other words, the consumption in town took all the water that was sent in, but many parts of the city had very low pressure or none. The new extensions and cross-connections give everyone water at fair to good pressures.

Last year's consumption was 33.2 per cent above that of 1936, which was 15.6 per cent over that of 1935. So far in 1938, up to May, the rate is 1 m.g.d. more than in 1937, or 17 per cent up. John W. Cunningham, superintendent, estimates that the consumption will reach 8 to 9 m.g.d. this year.

The six filters on the Nueces River at Calallen at the upper end of the conduit are rated at 1¼ m.g.d. each. Pretreatment supplies water to the filters at 10 p.p.m. turbidity. Improvement by providing flocculators and better mixing is planned to put water on the filters at 3 p.p.m. Additional filters and an increased rate may soon raise the total capacity to 16 m.g.d. In the rearrangement the filters are to be built in the existing coagulation basins and new pumps added.

The new 10-m.g.d. reservoir, designed and built under the direction of the Terrell Bartlett Engineers, permits filling at night with day-time drawdown. It is a unique circular structure with sloping sides, built half in excavation and half in embankment, with concrete lining and a groined arch cover.

City serves gas

While ordinarily a gas system is not included in the province of the city engineer, in Corpus Christi it is definitely under his supervision, since the gas system is owned by the city. Gas at high pressure, 1,000 to 3,000 lb., accompanies oil in many of the wells, the nearest of which is within 4 mi. of the city limits. Hundreds of flares burn the unused gas continuously, and one of the sights that the visitor long remembers is the night view from the hotel window landward out the main street, with the city's neon lights topped by a multitude of gas flares on the horizon.

Before the wells came in a manufactured-gas plant supplied the city. Now gas is purchased at the city gates at 100 lb. pressure (7½c. per 1,000 cu.ft. for the first 60 M. ft., 5c. for the next 60 M. ft., and 4c. thereafter). The rapid growth has put the gas distribution system under even more serious handicaps than those of the water system. Due to the small mains and the available high pressures, leak detection and repair becomes a major problem. Three pressure districts were established, depending on size of mains. The householder burns gas at 4 to 6-oz. pressure and the high pressure in the 100-lb. and 15-lb. feeders must all be reduced to service pressure by reducing valves. As enormous quantities leaked out of the mains at high pressures, the plan is to extend the 15-lb. feeders.

Leak detection in the outlying areas is by "rodding" holes to the pipe and "flaring" them. In town, however, "flaring" is too dangerous, and a chemical detector is used to sample the air in the holes for evidence of gas. Last year $150,000 was spent on leak elimination, extensions and feeder replacements. The city buys 160 M. ft. a month and charges 50c. per 1,000 ft., with 5-c. reduction after each 5,000 ft. Cost to those outside the city limits is increased 50 per cent, the same increase as charged water consumers.

Prospects of growth

These are some of the immediate problems of this rapidly growing city. But the city engineer and the city commission are constantly looking ahead to formulate policies and plans for the future Corpus Christi. Try as I could, no one was found to name a growth rate or an ultimate population figure. The rule laid down by the Chicago Regional Planning Association—to plan facilities for the time (no date) when twice the population has to be cared for—seemed to find some acceptance. The engineer must adopt some limit in his planning; to him it is vital.

Corpus Christi has before it a shining example of failure in prediction—in its sewage plant, designed for 9 years hence and already at its limit of capacity. Just how to evaluate the numerous factors which produce growth is an equation almost impossible to solve. Statistics collected by the Chamber of Commerce resemble those of the Florida boom; but the factors which are creating the growth of Corpus Christi seem basically sound. They are as follows:

Fuel in unbelievably large quantities right on the water front and an oil field tributary good for 40 to 50 years according to conservative geologists; an agricultural back country; a favorable climate, summer as well as winter, for the tourist; a rate-advantage territory of the port facility of 65,500 sq.mi., on which live more than 1,000,000 people (an increase of 24 per cent in the last 7 years). Mineral resources within this territory are numerous. Industries for processing and refining agricultural products are now augmented by a chemical plant, glass factory, carbon-black plant, 2 pottery works, 23 oil refineries, 98 oil well supply houses and 1 antimony smelter.

Against these optimistic factors an industrialist (an engineer, incidentally) outlined some offsetting factors. Here are two: (1) Shipload quantities of many commodities landed on the Eastern seaboard require immense storage facilities,

whereas carload lots can easily be distributed. (2) An equalization of labor cost by legislation would quickly eliminate present differentials. Such considerations make one pause and reflect that the present rapid growth may be only a bulge in the rate curve, destined to flatten out and approach the normality of other city growth curves.

Nothing has been said of city planning, but an excellent waterfront boulevard is under consideration, to be coupled with additional bay-front protection and land reclamation. A tax-remission fund of $850,000 ultimate amount would seem to be available. The pavement problem is acute with so small a percentage of the city's streets paved; several millions can be utilized here.

Of definite concern to the engineer is a proposed new charter which would extend the city, now 7 sq.-mi. in area, to include 14 sq.mi. This outer ring is already 95 per cent built-up, but its water, sewer and gas lines are all below minimum standards. Power of the city plan commission over plats and street pattern has been in effect only for the past year. Fortunately, Texas laws are such that Corpus Christi can vote a new charter extending its limits without a vote of those to be taken in.

The above items, which cover by no means all of the city engineer's problems, suggest what an unusual load of responsibilities rests on his shoulders. That he is part of the city's policy-making machinery goes without saying.

Centering Hung from Pier Umbrellas

A. Burton Cohen,
Consulting Engineer, New York

Construction of concrete arches of Binghamton, N. Y., bridge aided by unusual method of suspending steel arch centering

Construction of the three 128-ft. span concrete barrel arches of the Ferry St. Bridge at Binghamton, N. Y. (described in *ENR*, April 28, 1938, p. 613), was aided materially by a novel method of hanging the full-span steel arch centering from short cantilever sections of the arches. Supplementary features of the work included a suspended trolley beam for shifting the centering in each span sideways, and the use of strain gages to establish a uniform initial stress in the hanger rods.

The specifications called for the construction of each arch barrel in three parallel strips, and centering was provided in each span wide enough to serve one of these strips. Each center, consisting of four steel truss arch ribs, spaced 5 ft. 8 in. center to center, was supported at the ends by timber pile bents posted down to the pier footings. During the construction of the first arch strip, and just before the keys were poured to complete it, a weakness developed in the cap of the timber bent support, due primarily to the inadvertent reduction in the required number of posts, and the span collapsed. Since it seemed inadvisable to attempt to repair or replace the timber bents under water (they had been installed originally in the dry within the pier cofferdams), it was decided to seek some other means of centering support. The result was a method of hanging the centering from steel rods passed through short arch cantilevers or umbrellas built as a continuation of the piers and abutments which previously had been carried only to the springing line.

The plan provided for a group of four hanger rods at either end of the four trusses of each arch center, passing through a 4-in. pipe sleeve in the pier umbrella to a bolted bearing on the extrados. Fastening of the hangers to the ends of the arch center ribs was accomplished by special plate and angle straps attached to the gusset plates by structural rib bolts. The forward pair of rods of each group was 2½ in. in diameter and the rear pair 1¾ in.

The pier was found to be in perfect stability under the suspended load of the centering on one side only, since the vertical load applied in cantilever balanced the overturning moment of the horizontal thrust of the centering. The vertical reaction of a fully loaded center was 173,400 lb. and the horizontal thrust was 193,700 lb. This pier stability, however, was not maintained when there was a completed arch on one side of the pier and the loaded suspended centering on the other. Therefore a restriction was enforced to limit the removal of the centering on one side of the pier until the arch on the adjacent side had cured for two weeks. At this stage the latter had sufficient strength, acting as a strut, to resist the resulting eccentricity. This restriction did not cause any delay, since one week was required to prepare a span for pouring after the adjacent span had been completed, and it required three weeks to cure the concrete before the centering could be removed. Practically the entire superstructure of the bridge, consisting of 31,750 sq.ft., was completed in 4½ months.

Measuring rod stress

In erecting the centering, a Whittemore strain gage was used to excellent purpose to establish a uniform initial pre-stress in the hangers resulting from the tightening of the bolts. Variations in stress were adjusted by trial turns on the bolts until the elongations of all the rods in a group were approximately equal. With little care the variation could be limited to a three-point difference on the strain gage dial, amounting to a stress of 900 lb. per sq. in. Readings taken on all rods after each of the three pours of each arch barrel also revealed variations of stress from unequal friction of the truss blocks or irregularities in the setting of the truss. These variations could be materially adjusted by tightening the low-stressed rods. The pre-stressing of the hanger rods de-

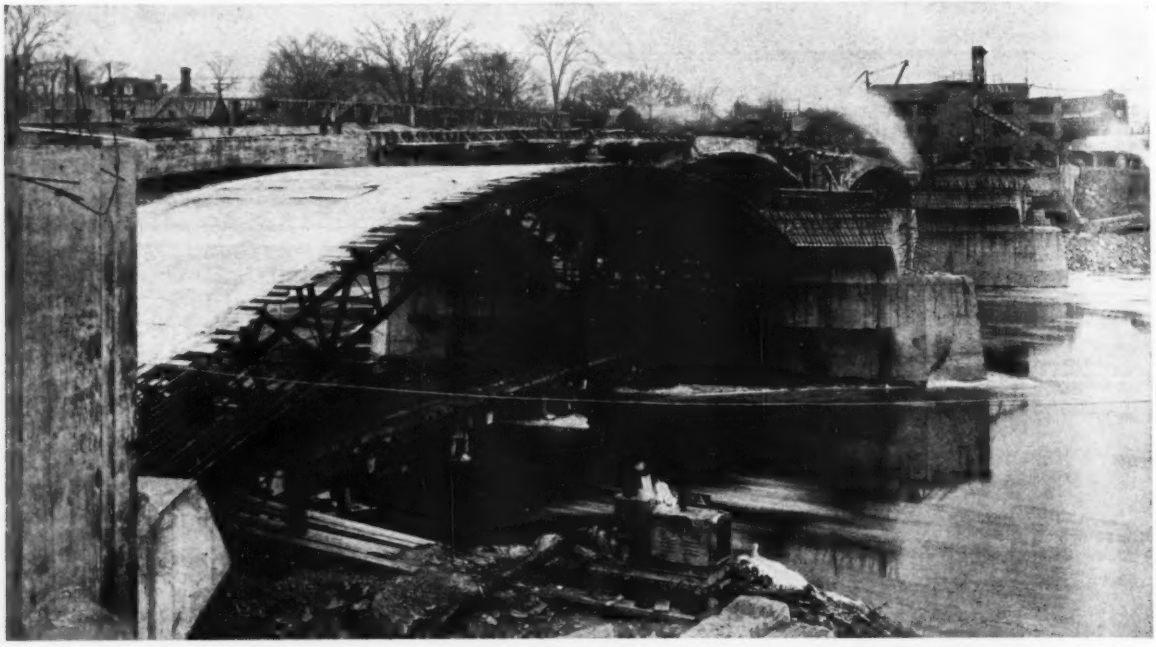
creased the amount of final elongation, which was so small as to cause no apparent irregularity in the curve at the cantilever construction joint.

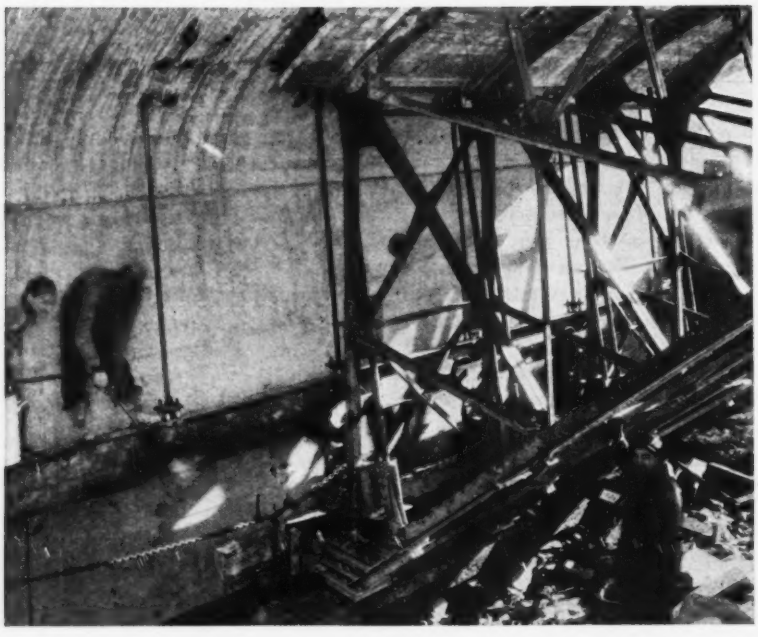
Moving the centering

For moving the arch centering laterally to the second and third positions, a 15-in. I-beam trolley 60 ft. long was suspended from one of the hangers of each group. Four 8-ton standard industrial trolleys were placed on the lower flange and each one fastened to the end shoe of a truss by a U-bolt hanger. Then the entire unit, with lagging in place, was pulled along the I-beam by two 5-ton puller jacks. The trusses were equipped with tie rods to resist the horizontal thrust of the unloaded centering to make the arrangement practically frictionless.

This combined scheme of supporting and moving the centering offers many possibilities in reducing the hazards and simplifying the construction of concrete arch bridges whether over waterways or highways or railroads where traffic must be maintained during construction.

The contractor on the bridge was the James McGraw Co. of Philadelphia. The writer was consulting engineer on the project for the city of Binghamton.





Centering suspended from hanger rods eliminates need for pile supports. Views at top and at left-bottom show centering being moved laterally. Right-bottom view shows use of strain gage to determine stress in hanger rods.

Handling Corners in Rigid Frames

B. J. LAMBERT AND C. J. POSEY
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Design suggestions on a troublesome but vitally important element of the popular rigid frame

WITHIN the last decade the rigid frame type of construction has achieved wide popularity, and has been the subject of considerable discussion in the technical press. The literature thus far has been chiefly concerned with the proportioning of main members and with methods of analysis of the indeterminacy of the continuous frame. Little attention has been paid to the design of corners. Lately, however, there has been a growing realization of the fact that serious overstresses may exist in corners designed according to conventional methods. A program of tests to compare various designs is now under way at the Bureau of Standards. The writers wish to point out a number of details of design that have an important effect on the strength of corners.

Concrete—rounded corners

Consider first a reinforced concrete corner or knee, rounded inside and outside, as shown in Fig. 1. Depending upon the loading conditions and design of the entire structure, this knee may be subjected to bending moments causing either tension or compression on the inside of the bend.

If the bending produces tension at the inside corner, stirrups will be required to prevent the main reinforcing bars from pulling away from the member on the inside, and pushing away on the outside. The stirrups will have to be securely attached to the main bars, so that motion of the main bars will be reduced to a minimum. The total stress in a stirrup due to the tension in the bar may be computed by statics if the stirrup spacing and bar curvature and stress are known. From the force diagram,

$$S = \frac{p}{R} \cdot T$$

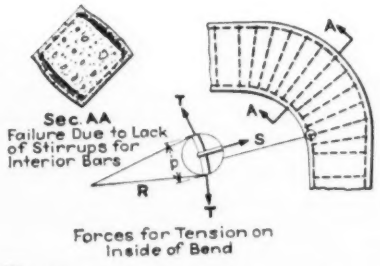

Fig. 1. Rounded concrete corner reinforced for either positive or negative moment

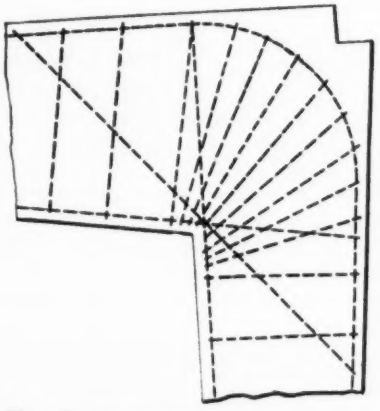

Fig. 2. Sharp concrete corner reinforced for either positive or negative moment

where S is the total stress in the stirrup, T is the total tension in the main bar, R the radius of curvature of the main bar and p the chord distance between adjacent stirrups. If there are several bars on the inside of the bend, each one must be provided with stirrups, to prevent the type of failure shown in AA of Fig. 1.

The stirrups have a similar function at the outside of the knee. The main bars have a compressive stress and tend to push away from the concrete. The total stress in the stirrups due to the change of direction of stress in the bar is given by the above formula. Here, however, the stirrups have an additional function. The main bars, being in compression, will tend to buckle in the direction of their curvature. They will have to be stiff enough, in the unsupported interval between stiffeners, to resist this tendency. The concrete will undoubtedly assist in preventing such buckling, but the amount of such assistance is uncertain because it depends upon tension in the concrete. Tests alone will disclose the maximum permissible ratio of stirrup spacing to diameter of main bar. These stirrups have somewhat the same function as the spiral reinforcement in columns. They are even more necessary, because of the initial eccentricity.

When the bending moment is such as to produce compression on the inside of the bend, no stirrups are needed. In this case, however, it is important that the bars on the outside of the corner be curved to a sufficiently large radius to prevent crushing of the concrete on the inside of the bend, or splitting in the plane of the bar.

Concrete—sharp corners

Occasionally concrete frames are built with sharp corners. For such a design if the moment causes tension on the inside of the bend, it is well to extend the inside bars through to the far face of the member, and to provide extra diagonal bars as shown in Fig. 2. Compressive steel on the outside face should be bent to a radius, and provided with stirrups as in a round corner frame.

If the moment produces compression on the inside of the bend, conditions are much the same as for rounded corners. Again, the bars on the outside of the bend should be curved to a sufficiently large radius to prevent crushing of the concrete. The stress concentration at the sharp inside corner is not nearly as seri-

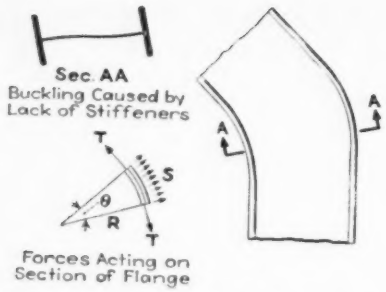

Fig. 3. Rounded steel I-beam corner with web reinforcement omitted

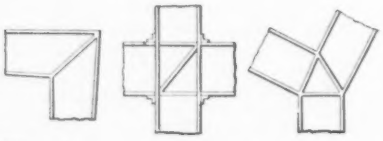

Fig. 4. Sharp steel I-beam corners with web reinforcement

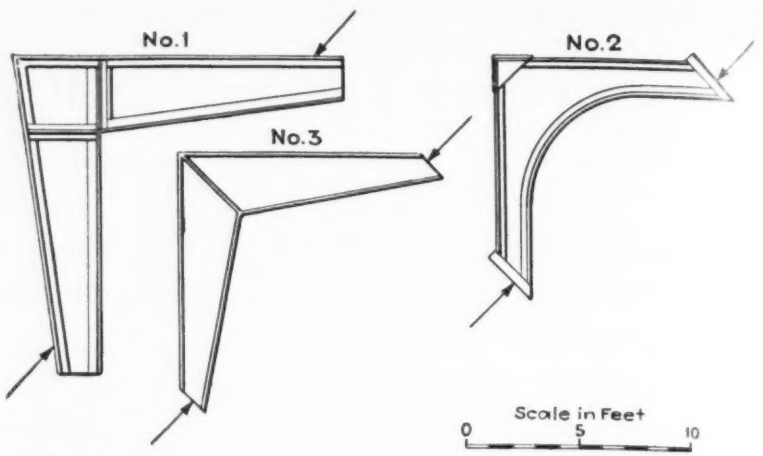

Fig. 5. Steel knees tested at Bureau of Standards of which No. 3 exhibited a distinct superiority when measured by the ratio of strength to weight of material required

ous as might be imagined, since the concrete is in compression in two directions at right angles to each other. Its strength under such a state of stress is considerably higher than in simple compression in only one direction.

Steel—rounded corners

In a steel frame, if the corner is of I-section, with the flanges following rounded curves, frequent stiffeners may be required, just as closely spaced stirrups are required for the reinforced concrete knee. In this case, however, they are likely to be required for bending in either direction. If the bending produces tension in the inside flange, the web will be in tension across planes parallel to the flanges, and if the radius of curvature is small, the tension may be very great. Referring to the force diagram in Fig. 3, it is seen that the tensile unit stress s in the web may be approximated by the formula

$$s = \frac{2T \sin \theta/2}{R\theta \cdot t} = \frac{t \sin \theta}{R\theta \cdot t} = \frac{T}{Kt}$$

in which T is the total flange stress and t the web thickness. In case this tension exceeds the allowable value, stiffeners welded to take tension should be provided or a thicker web should be used. It should be noted that the outer flange will tend to buckle. Stresses due to this action will be lessened, if tension "stiffeners" are provided.

If the moment puts tensile stress in the outer flange and compressive stress in the inner flange, the web

RESULTS OF TESTS ON STEEL RIGID FRAME KNEES AT THE BUREAU OF STANDARDS

Specimen No.	Weight lb.	Design load lb.	Maximum load lb.	Max. load ÷ design load (factor of safety)	Relative values of max. load ÷ weight, or strength-weight ratio
1.....	3,610	67,900	168,000	2.48	.62
2.....	2,800	56,800	72,000	1.27	.34
3.....	2,030	73,800	153,600	2.08	1.00

is in transverse compression, the amount of which may be computed by the formula given above. The allowable stresses in compression are less than in tension, so that stiffeners are more likely to be needed than before, though they need not be welded at the ends to take tension unless stress reversal can occur. The web, if unsupported, will tend to buckle as shown in Sec. *AA* of Fig. 3. The length to be used in applying the column formula is the full depth of the web, for either half of the web is equivalent to one half of a pin-ended column. Using the column formula of the American Institute of Steel Construction, the allowable stress in lb. per sq. in. is

$$f = \frac{18{,}000}{1 + \frac{1}{18{,}000} \cdot \frac{d^2}{\frac{t^2}{12}}} = \frac{18{,}000}{1 + \frac{1}{15{,}000} \cdot \frac{d^2}{t^2}}$$

where d is the depth of the web in in., and t the web thickness in in. The allowable stress is, of course, limited to a maximum of 15,000 lb. per sq. in.

There is some question, in the case of rounded corners, as to the correct method for computing the unit stress in the flange. The writers believe that it is reasonably accurate, if not entirely logical, to compute the unit stress at the points of tangency on each side of the curve, using the ordinary beam formula and correcting for the stress due to direct thrust. The flange stress in the curve may be considered to be equal to the greater of the two values so obtained.

Steel—sharp corners

The high web stresses which must be reduced by thickening the web or by using closely-spaced stiffeners, in the case of knees with rounded corners, may be avoided by making the corners sharp, and providing a single stiffener to take the entire thrust occasioned by the change in direction of the flanges. Corners of this type are shown in Fig. 4. The diagonal stiffener in the center sketch is not needed when the moments are nearly symmetrical but should be used when considerable moment "turns the corner." This diagonal stiffener interferes with the framing of beams to the column web and, if omitted for this reason, the web should be reinforced unless it is sufficiently stiffened by the framing angles.

Tests of steel corners

Tests recently made at the National Bureau of Standards, in cooperation with the American Insti-

tute of Steel Construction, present an interesting opportunity for comparison of the different steel frame types. The data are presented in progress reports Nos. 1 to 10, issued by the A. I. S. C. The table on page 148 is a summary of the test results. The last two columns of comparative values have been added by the writers.

The first and third specimens (Fig. 5) failed by buckling of the flange angles adjacent to the inner corner. The second specimen failed by buckling of the web. The superiority of the third design is clearly shown, a superiority believed not to be due so much to its welded construction as to the general arrangement of the material. It seems reasonable to suppose that this design could be further improved by reinforcing the compression flanges near the inside corner.

Small Shields Drive Tunnels For Staten Island Sewers

Bores lined with tight-joint precast concrete blocks will carry storm water to the sea

Two interesting storm drains have just been completed by WPA for the borough of Richmond, Staten Island, N. Y. Both are in tunnel, shield driven, lined with tight-joint precast trapezoidal concrete blocks, erected during driving operations. No secondary lining will be required, as the tongue-and-groove joints in the blocks are sufficiently watertight for drainage purposes. One sewer is a 6-ft. bore, 750 ft. long, on a 3 per cent upgrade under Jersey St. The other, 4 ft. in diameter, extends for 1,200 ft. under Carey Ave. They are part of an extensive storm drainage program being carried out by WPA on the hilly island. Features of the work include use of the tight blocks, eliminating the joint pointing grooves formerly used on this type of tunneling; the steep grade on the Jersey St. job; and the installation of manholes after the tunnel was driven on the Carey Ave. section.

Shield design

The two shields are similar in design, except for size and number of jacks. Both shields are 10½ ft. overall length, equipped with banks of two-pressure jacks, high pressure for shoving and low pressure for holding the blocks in place. The 6-ft. machine has 24 double-cylinder 4-in. jacks with concentric, interior 3-in. cylinders for the low pressure operations; the 4-ft. rig has 18 jacks of similar size and design. Both machines are articulated at the center; the forward and rear sections being held together by four screw jacks at the quarter points which provide directional control in addition to that afforded by the pressure jacks.

Hydraulic pressure for the jacks is supplied by oil in a closed circuit, the pressure being built up by a small air pump attached to the shield. Reducing valves split the oil circuit into high-pressure and low-pressure lines.

Muck is removed from the face by hand shovels, the material being loosened by pneumatic clay spades or chisels when necessary. An inclined belt conveyor, air driven, carries the muck from the face through the shield to the bucket on a flat car. The front half of the car is equipped as a cradle to haul enough blocks into the tunnel for one shove of the shield.

Trapezoidal blocks

The precast concrete blocks for the tunnel lining are trapezoidal in shape; 24 blocks make up a ring for the 6-ft. tunnel, eighteen for the 4-ft. bore. A ring of the larger blocks advances the tunnel 10 in.; the smaller blocks are 8 in. long parallel to the tunnel axis. Inner and outer faces of the blocks are curved to form a true circular lining. Large blocks are 6⅛ in. thick, and weigh 63 lb. each; the small segments are 4⅛ in. thick, weighing 32 lb.

The blocks are divided into two types, pushers and fillers, which occupy alternate positions in a complete ring of lining. The pushers, so-called because they bear the brunt of the shield shoving, have tongues on the sides and leading (narrow) end and a groove on the back end. They also have a longitudinal rib on the interior face which is used for lining up purposes when setting a new ring of blocks. Fillers have grooves on the sides and front (wide) end and a tongue on the rear end. Thus, a complete ring not only is fully interlock-

Fig. 1. Small shield-driven tunnel lined with tight interlocking trapezoidal concrete blocks serves as storm drain on Staten Island.

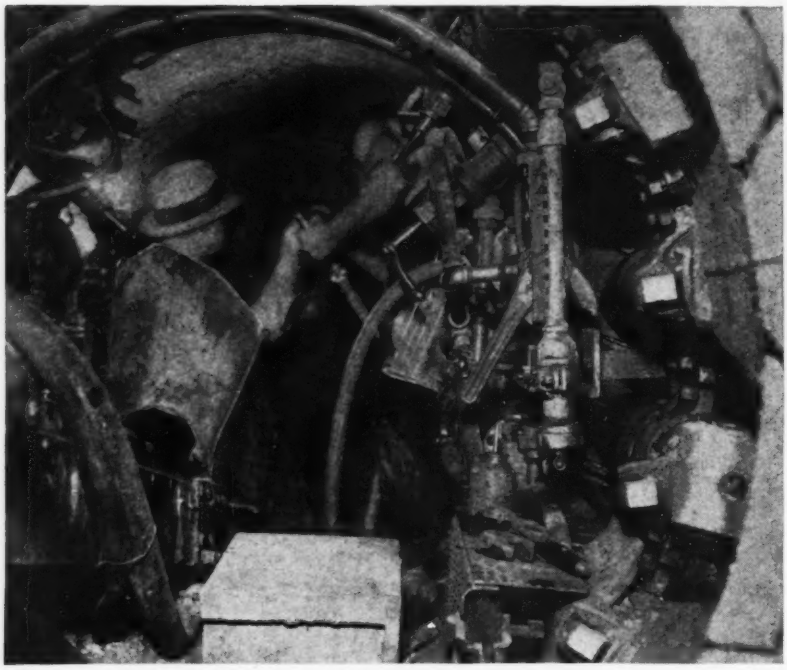

Fig. 2. The 6-ft shield at work. A shove has just been made, and the bank of alternate shoving jacks is extended against the pusher blocks. The other bank of jacks is retracted to permit setting of the filler blocks to complete the new ring of lining.

ing in itself, but is locked into the previously set ring to provide a complete interlocked wall of lining. All contact faces, tongues and grooves of the block are dipped in hot asphalt before setting to provide a mastic-cushion and seal at all joints.

The blocks are made in hydraulic hand presses with a 1:1.8:2.2 mix, the coarse aggregate being ½-in. gravel. Desired compressive strengths of 2,500 lb. per sq.in. in seven days and 3,500 lb. in 28 days are invariably surpassed.

Driving procedure

At the completion of setting a ring of blocks, all jacks are in extended position against the segments. To start a new shove, the bank of alternate shoving jacks is retracted, leaving space for insertion of a new set of shoving blocks between the jacks and completed ring. As fast as these blocks can be placed by hand, the low-pressure cylinders of the shoving jacks are released to hold the blocks in place. This pressure is insufficient to move the shield, but when all of the shoving blocks are in place, the valves to the high pressure cylinders are opened, shoving the shield ahead the distance of a ring width.

By the time all shoving blocks have been set the jacks for the filler blocks have been retracted. Then, while the face is being mucked out, the filler blocks are set between the shoving blocks, and their low pressure jacks are released to hold the blocks in place. There is no key segment, as the trapezoidal shape of the blocks and clearance of the jacks permits the filler block to be placed from the front end.

Muck is discharged directly from the conveyor into the waiting bucket on the narrow gage car. On the larger tunnel, driven upgrade, the car is handled by an air hoist and cable, on the 4-ft. bore it is pushed in and out of the tunnel by hand.

Both tunnels were driven from shallow shafts equipped with gasoline hoists for lifting the buckets out of the hole. A structural steel ring, fabricated with heavy knee braces, was set up at the portals as an anchor against which the shields shoved off, first riding on concrete cradles.

Both tunnels were practically dry, so drainage was no problem. No trouble was experienced in driving the large tunnel up the steep grade, although precautions had to be taken to prevent the muck car from running away. There are no manholes

Fig. 3. The block lining is set in place by hand. This workman is placing a filler block between two previously-set pusher blocks. As fast as the fillers are set, low-pressure jacks are extended to hold them in place.

entering the larger tunnel, but there are several connected with the 4-ft. bore. These were sunk from the surface after the shield had passed the point of location, the top blocks of the lining being broken out from above.

The jobs were worked two 8-hr. shifts per day, five days a week. Except for supervisory forces, the job personnel was made up of work relief labor. Both shields and the block-making equipment were rented from the Link-Belt Co. of Philadelphia. John Neamand represented the shield owners on the job.

The department of public works, borough of Richmond, George Allison, commissioner, is sponsor of the projects. For the WPA, Edgar Groves is director for Staten Island, and George Wort is assistant chief in charge of sewer construction.

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Reflectors Cut Accidents In Three-Month Test

IN THE three-month period since a system of reflectors outlining the margin of the road was installed on U. S. Highway No. 16 from Lansing to Detroit (*ENR*, April 14, 1938, p. 541), highway accidents at night declined 79 per cent from the same period last year as compared with a decline of 37.5 per cent for daytime accidents. Nine night accidents, none of them fatal, occurred on U. S. 16 between April 6 and July 6, whereas in the same period last year there were 43 night accidents, four being fatal.

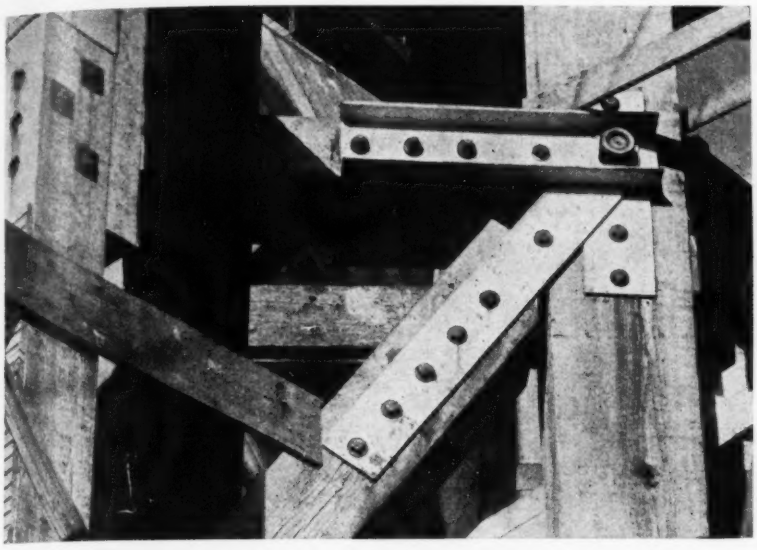

FIG. 1. STRAP-AND-PIN JOINT FUNCTIONS WELL IN TENSION OR COMPRESSIONS

A New Timber Framing Joint

JOHN J. GOULD

Chief Structural Engineer, Golden Gate International Exposition, San Francisco

Connection of "strap-and-pin" type developed for San Francisco exposition structures combines efficiency of steel with economy of timber using metal connectors

TIMBER is used extensively in structures now being built for the 1939 Golden Gate International Exposition in San Francisco, and the amount of timber framing to be done in this $18,000,000 construction project made it important to select the most effective and economical designs. A detail worthy of particular study was framed timber joints. So many of these are needed that the adoption of simple, safe standards was a matter of some importance. Accordingly, numerous types of timber joints were considered; several were selected for use under certain conditions, and one was developed into a new form which has been called the "strap-and-pin" type. It has several advantages over other types, particularly where stress reversals occur.

At the outset the design problem was to find the most satisfactory methods of framing for the decorated structures to house 750,000 sq. ft. of exhibit area in main palaces and for the ornamented towers, gates and approaches that were required to give the desired setting. In general, the decision was for typical main exhibit palaces 200 ft. wide and 886 ft. long. Timber arches of 200-ft. span were used in the main palaces, and timber A-frames of special design were selected for some of the ornamental towers. In the investigation of framed timber joints for these structures four types were compared:

(1) Joints in which timbers are connected by means of split rings between the individual timbers of built-up chords and webs.

(2) Joints in which members are fastened together by plywood gusset plates and split-ring connectors, the members consisting of solid or laminated timbers.

(3) Joints using butt blocks to receive compression members and steel rods to carry tensile stresses, commonly known as Howe type.

(4) A modification of the pin-connected steel eyebar truss joint adapted to timber framing.

The fourth type, which is being employed extensively, was given the name "strap-and-pin" type. Its advantages are simple design and low cost.

The improved type of joint, shown in Fig. 1, is a combination of timber members from which stresses are transferred through flush shear-plates and bolts to metal and then to other members through a pin-bolt connection. The reasons for selecting this type of connection were:

(1) The joint is made with less steel than would be required if the conventional full steel gusset plates were used, and these plates were also objectionable in some of the more complex tower joints because of interference with framing in other directions.

(2) Secondary stresses caused by deflection are reduced to a minimum because of the pin-connected joints.

(3) Shrinkage compensation in this type of joint is made by simply tightening the bolts in the joint plates and the pin bolt. No "drawing together" of the frame is required because the original working lines are maintained. This latter is an advantage in exposition structures because shrinkage, especially if cumulative, will often result in damage to plaster ornamentations.

(4) By using shear plates the erection procedure is easy, the detrimental effect of checking (particularly objectionable when only bolts are used) is minimized, and stitch bolts are eliminated.

(5) The salvage value of the timbers and of entire structures is greatly enhanced because dismantling and subsequent re-erection in a new location is facilitated.

(6) Perhaps the greatest advantage is that the joints work equally well in either tension or compression. Thus the use of long, solid timber members is possible where stress reversals occur. Under these conditions the strap-and-pin type may mean reduction of the number of joints and often a marked simplification of the general framing scheme.

Extensive use of the new type joints was made in the south towers of the exhibit palace group, which are 108 ft. high, of irregular plan, and about 65 ft. wide. These towers,

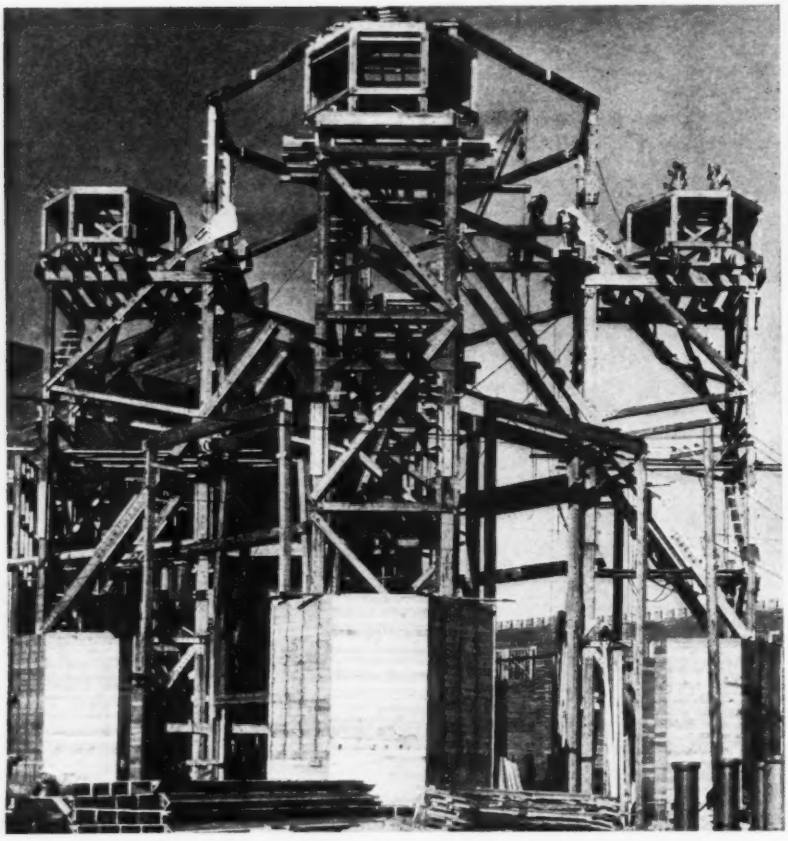

Fig. 2. Framing of a tower 180 ft. high and 64 ft. wide in which a variety of connections are used.

are of modernized Persian architecture and supply the motif for the south garden area. Supports for the towers are essentially two sets of *A*-frames placed at right angles to each other.

Fig. 2 shows the south tower, west, in which the lower members of the *A*-frames are taking shape. Several different types of joints can be seen where different stress requirements obtain at a higher level; some of the main *A*-frame members were provided with strap-and-pin joints at the lower end, and steel gusset or some other type at the upper end.

The joint illustrated in Fig. 1 frames a 30-ft. diagonal to a column and to a horizontal strut by means of 7 x ½-in. steel straps. The column was also provided with a strap, while the horizontal member, which delivers horizontal bending and direct stress, is brought into the joint through a pair of 8 x 3½-in. x 22.3-lb. channels. Wherever horizontal bending occurs channels are required; otherwise only flat plates are used.

Straps and channel are overlapped and interconnected by a bolt of 2½-in. diameter which serves as a pin or common connection for the joint. The thickness of certain timber members is increased, where necessary, to allow for the overlap of the steel plates. In all cases the straps are connected to the timber by means of flush shear-plates of 4-in. diameter. The pair of ½-in. steel straps on each timber is attached to it by ¾-in. bolts whose number is determined by the total load to be carried.

Fabrication of the strap-and-pin joints is facilitated by use of a plywood template made from the drilled holes in the prefabricated steel strap. From this template holes in the timber members are bored in from each side to a point halfway through the timber, making the hole diameter about $\frac{1}{16}$ in. larger than the bolt. In some cases the contractor preferred to use the steel straps as templates. Erection is similar to that of a steel structure after the individual members have been fabricated on the ground and are ready to be connected up in place.

Plans and specifications for the exposition structures have been prepared by the exposition company's department of works, through the divisions of structural engineering and architecture. The entire works program is being carried out under the general direction of W. P. Day, vice-president and director of works, with H. C. Vensano as chief of construction. E. T. LeSure was general contractor on the south tower framing of the exhibit palace group.

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Beavers Used on Streams For Reclamation Work

CONTINUING a program initiated about two years ago, the division of grazing of the Department of the Interior is moving about a hundred beavers per month, this season, to small streams on federal grazing districts in Idaho. The dams the beavers build are intended to check soil erosion and store water supplies.

First experiments with the use of beavers were made in 1922, when some were placed on streams in the Arrow Rock federal irrigation project in Idaho, where they succeeded in checking silting on three good sized tributaries. With the establishment of federal range areas under the Taylor Grazing Act of 1934, the use of beavers was resumed about two years ago.

Under the present program, beavers are trapped on streams where their work is not needed and kept for a few days in CCC camps in the area. They are then transported in groups of twenty to the new scene of operations.

To protect the beavers from coyotes in the early stages of their work, Civilian Conservation Corps forces construct temporary dams in the stream. These temporary dams are usually completed by the beavers in about ten days, and the animals then build about five dams each season.

The cost of placing each beaver averages $5, and the Division estimates the value of the work done by each animal at about $300. About 200 beavers were moved last season, and in the present season it is planned to place about 600 animals. The work is being carried out through cooperative agreements with the Idaho State Game Department, the U. S. Forest Service, and the U. S. Biological Survey.

Civil Engineers Meet in Salt Lake City

Transportation, irrigation and water conservation, topics appropriate to the region, are discussed at the Am. Soc. C.E. annual convention

A SYMPOSIUM on transportation, seven papers on irrigation, five on highways, three on sanitary engineering and four on surveying and mapping comprised the technical program for the American Society of Civil Engineers annual convention held at Salt Lake City July 20-23. Henry E. Riggs, in the annual address of the president, confined his discussion largely to the humanities of the engineering profession. This was quite in line with action on welfare subjects taken by the board of direction and with discussions at the Local Sections Conference, both preceding the regular convention sessions.

Engineers and the society

In opening his discussion of "The Relation of the National Society to the Engineering Profession," Dr. Riggs described the blighting effect of the depression on the individual engineer and on the profession. Lack of employment with attendant loss of opportunity to assume responsibility, "made-work" programs, many without engineering supervision, government competition, low pay, labor unrest, stifling of individual initiative, all compel analysis of conditions in the engineering profession, said Dr. Riggs. He then proceeded to the question of what the society should do to keep up morale and to eliminate abuses which engineers have experienced.

As background for his comment Dr. Riggs outlined the present set-up of the society with its sections, junior organizations, student chapters, technical divisions and committees. Startling is his statement that 23.7 per cent of the membership is of the junior classification, also that essentially the junior group is the only one on the increase. This creates a present problem, but according to Dr. Riggs it augers well for the society if the young men can be put to work in and for its development.

The three major problems seen by Dr. Riggs relate to the sections, the technical divisions and the juniors. Activity with respect to legislation affecting the profession, increased membership, development of the juniors and cooperation with other units of the profession, Dr. Riggs holds, are obligations of the sections.

Returning to welfare questions Dr. Riggs said in part: "The most annoying problem of the present day is that of unionization. With labor leaders active in the attempt to bring every employee group into some form of union organization, with political and official pressure being brought to bear in some states or cities to compel such affiliation, many young engineers and employees in subengineering positions need some professional society or group to turn to for advice and support.

"The true answer is that engineering is a profession and not a trade. The labor union or trade union does not solve the engineer's problems, and he has no rightful place in the unions because his professional obligation makes him the arbitrator or umpire between the owner and builder, or the public and the contractor on public works. Unless the engineer is a member of a professional society which can and will speak for him, and unless his society has the support and backing and hearty cooperation of the other societies of the profession in that state, he has little chance of having his argument listened to.

"The societies can no longer devote themselves exclusively to matters of technical theory, construction methods and materials, or of design and research. They must give more thought to registration and the enforcement of registration laws; to the merit system in civil service; to proper classification of employees, and not only to the fixing of adequate salaries for each class, but to insisting that those salaries be paid. They will have to give thought to such matters as political discrimination against engineers, unjust discharge, and many other matters that involve the relationships of the engineer employee of city, state, or federal government. This concept is repugnant to many members of the profession.

"There is no sound reason why a technical society cannot and should not, through its sections, extend its activities to include also all matters which have to do with the financial and economic well-being of its members. Failure to do so will result in the attempt to organize new societies with this objective and it is obvious that in times like these the long established and financially solvent Founder Societies are in much better position to accomplish definite results than any new group whose energies must be devoted largely to organizing and securing new members."

Rail transportation

F. Lavis, consulting engineer, New York, opened the symposium on transportation with a review of the present status of the five agencies: railways, highways, waterways, pipelines and airways. Some of the points made are as follows: In spite of competing forms, railways are the dominating factor in the field of transportation, moving two-thirds of freight of the country. Waterways carry 18.3 per cent; trucks, 8 per cent and pipelines, 6.1 per cent. These figures are ton-miles. Trucks, because of short hauls, handle more actual tons than indicated. Figures given by J. S. Worley in *ENR*, June 11, 1936, p. 837, also were noted. Comparing capacities, the author stated that it would require 10 to 12 two-lane highways to carry the same freight as a railroad such as the Pittsburgh Divi-

sion of the Pennsylvania now carries. These and other figures were given to indicate the dominating position of the railroads and their importance in the industrial life of the country.

As to advancements, the railroads are not making anywhere near the progress which the present state of the art permits. Lack of capital (due to lack of earnings) is the reason. In the last 7 years the railways spent only 49 per cent as much money annually for maintenance as was spent annually from 1925 to 1929. Deferred maintenance at the end of 1937 amounted to a billion dollars. Pump priming money for the rails seemed to Mr. Lavis legitimate. Extension of government credit to the railways should be placed on an equality with highways, airways and waterways in his opinion. Then the government would be in the same position as to railway properties as it is with the highways.

Ralph Budd, president, Burlington Lines, spoke of the satisfactory experience of his lines with Diesel-powered light weight trains. A much greater opportunity for savings, he said, exists in lightened freight cars, but funds to build them are lacking.

A new type of turbo-electric locomotive of 5,400 hp., about to be put into service on the Union Pacific, was described by C. P. Kahler, system electrical engineer. This two-unit assembly is a traveling steam-electric generating power plant in which the steam is exhausted into an air-cooled condenser from which the water is pumped back to the boiler with only 2 per cent of make-up water added.

Highway transport

Highway transportation and its many problems such as tax diversions and traffic regulations were covered by L. I. Hewes, deputy chief engineer, Bureau of Public Roads. Notable points are: Road use has increased 73 per cent in 10 years. Highway design is conditioned on trucks which increased 47 per cent in number in the last 10 years as compared with a 22 per cent increase in cars. Most outstanding is the nation-wide highway planning survey. One conclusion from this survey is that 5,000 miles of multiple-lane highways, with a traffic capacity of over 4,000 vehicles per day, is all that is now required in this country; already there are 3,452 miles of such highways. The survey shows that the prevailing use of highways is for short trips. In eleven scattered states only 1.6 per cent of the movements were as much as 40 to 50 miles.

S. R. Newman, United Air Lines, outlined the development of aviation during the last decade and the various flying aids and ground facilities making for safety, speed and continuity of service.

Irrigation

Held in the heart of the irrigation area, the sessions of the irrigation division attracted the greatest attendance. A water conservation conference sponsored jointly by the Utah Sectional Committee on Conservation of Water and the Utah Section, Am. Soc. C.E., held on Tuesday, added materially to the interest of the irrigation engineers in the convention.

O. W. Israelsen, Utah State Agricultural College, presented a history of irrigation since the coming of the Mormon pioneers in 1842. From 1850 to 1880, Utah had one acre of irrigated land per person. Then the proportion increased very rapidly up to seven acres per person in the rural districts and two and a half acres to the total population. Reduced productivity, exports, increased needs were all noted as causes. The building period, water rights and factors in making irrigation permanent were other subjects discussed.

In a meaty paper on the "Development of the Colorado River System in the Upper Basin," T. C. Adams, University of Utah, reviewed the seven-state compact, which provides that 7,500,000 acre-ft. annually shall be allotted each to the upper and lower basins. The average annual flow for the 17 years since the signing of the compact has been 14,930,000 acre-ft., barely sufficient to meet this one compact provision and leaving nothing for Mexico which without grant has been using surplus waters amounting to something less than 1,000,000 acre-ft. This, Mr. Adams says, must be deducted equally from the upper and lower basin allotments. When the compact was signed the average annual flow at Lee's Ferry was believed to be from 17,000,000 to 19,000,000 acre-ft. (including water consumed in the upper basin). The eventual needs of lower-basin projects are estimated at 6,200,000 acre-ft., yet the average yield during 10-year series of dry years just passed has not been more than 5,400,000 acre-ft. Unavoidable losses and a grant to Mexico must be included.

Consequences of the lower-than-anticipated flows are summed up as follows: 1. A lower reliable flow than anticipated is available. 2. Any increased use above that planned will cut into the upper-basin allotment. 3. Financial aid to upper-basin development from the Boulder Dam fund is of doubtful maturity. 4. Large upper-basin storage will be desirable before final development is attained. 5. A build-up of Mexican rights from the use of surplus flows to the detriment of the upper basin is possible. An amicable agreement now is urged, failing which a system of regulations making further Mexican development impossible should be made.

E. D. Larson, U. S. Bureau of Reclamation, and E. A. Jacob, city engineer, Provo, described the plan and construction problems of the Deer Creek Project (*ENR*, June 20, p. 899).

Conservation

Conservation of water through recharge of underground supply was considered in a paper by A. T. Mitchelson, U. S. Department of Agriculture. The practice of spreading was initiated by the Denver Union Water Co. to augment the water drawn from a gallery system in Platte Canyon. Present spreading is done by basins, flooding, furrows and by pits and shafts. Factors affecting the efficiency of each method were given. Experiments are being conducted by various federal and state agencies to determine these factors.

Luther M. Winsor, U. S. Department of Agriculture, spoke of the relation between flood control and water conservation as related to the torrential streams in the arid West where water has a great intrinsic value. The carrying power of a stream varies as the sixth power of the velocity. In consequence a velocity reduction of one-half will permit a stream to drop sixty-three sixty-fourths of its load. Barriers at the mouths of canyons are built to create stilling pools which will produce this large reduction in load. The system, as Mr. Winsor stated, has been used with success in Utah, Nevada, Arizona, New Mexico and Texas. Los Angeles uses a modified form. Back

of the Garfield smelter near Salt Lake a barrier has been raised three times, the last time 100 ft. above stream bed. A novel type of rubble-concrete-masonry construction for spillways and walls is employed using boulders brought down by the floods. Boulders are placed close together with the thick end of each rock on the outside, the long axis pointing inward and downward. Concrete fills the void. Costs were given as $6 per cu.yd.

Snow surveys

George D. Clyde, Utah Agricultural College, outlined methods for forecasting seasonal water supply for irrigation from snow surveys and day-to-day flow from a study of hydrographs. Enough surveys have been made to develop a relation between snow cover and runoff but every watershed, he indicated, seems to be a law unto itself, hence the snow cover-runoff relationship must be worked out for each watershed. Only one measurement of snow courses is necessary and that at the end of the precipitation season; the total accumulated precipitation only is needed as a basis for forecasting.

Snow stakes generally have been abandoned for the Mt. Rose snow sampler which consists of a 22-gage aluminum tube 1¾ in. in outside diameter with a tool steel cutter with a 1.485-in. inside diameter fastened in the end of the tube. The tube is calibrated along a slot so that the length of the core may be observed. A tubular spring balance has been developed at the Utah Experiment Station for determining the water content of the snow core.

In Utah, snow surveys cover 85 courses, most of them above 8,000 ft. elevation. Some 500 similar courses are being surveyed in other western states.

Illustrative of the utility of the snow surveys and forecasting, Dean Clyde cited the warnings given prior to the 1934 drought when crop planting was curtailed and a drought conference called by the Governor before the drought occurred. The conference resulted in a water conservation program and in the development of supplementary water supplies. Salt Lake sunk several wells. Farmers were educated to secure the maximum use of the water available as well as to curtail acreage. Livestock was moved off the ranges and out of the state before they starved or choked to death. Some 400,000 acre-ft. of water was developed and the program saved $5,000,000 in Utah alone.

As most of the water diversions in Utah are from natural flow, the rate of fall of the stream as the season progresses becomes important in equalizing deliveries which are usually in rotation among users in each canal system. On a stream which falls rapidly the user who gets his turn early in the period gets a larger stream than the one near the end of the period. If the characteristics of the stream are known the water commissioner can deliver water in acre-ft. per month, making possible a "rotation-on-demand" system. Similarity of hydrographs of streams without storage reveals, said Dean Clyde, such a striking uniformity of slope during the falling stage that it is possible to fit previously determined curves to the observed curves after the river discharge has reached a maximum and is on the decline. Group mean curves on the Weber, Provo, Ogden and Logan rivers were shown which are used to prepare curves of future discharge for use as templets.

Highways

A. C. Spann, U. S. Bureau of Public Roads, and Lee Wendelboe, Utah State Road Commission, presented a paper on the "State-Wide Highway Planning Surveys." The paper covered essentially the same information as was given for the whole nation in recent issues of *Engineering News-Record*.

"Highways from the Users Standpoint" was the title of a paper by Chester H. Gray, director, National Highway Users Conference. Mr. Gray discussed the tax situation particularly diversions. He deplored attempts to equalize all transportation methods as to rates, rules and regulations and advised relief for the railroads from strait-jacket regulations.

Sanitation

Three papers relating to water, sewage and wastes were presented to the small group of 30 who made up the audience for the sanitary engineering division. Dana E. Kepner, Denver, spoke on sewage and garbage disposal needs of the western states, E. B. Black, consultant, Kansas City, described the recently completed Denver Sewage treatment works, and a paper by Harrison P. Eddy read by A. M. Rawn, described modern incinerator practice. Topics noted included the more modern method of burning sewage sludge by the multiple-hearth rabbling furnace adapted from the metallurgical field and the type which burns the sludge in the form of a pulverized mixture of filter cake and dry sludge which is blown into the furnace. Refuse-burning furnaces, Mr. Eddy stated, consist essentially of the same elements as any coal-burning furnace for house heating or power generation, modified as necessary for burning the particular type of fuel. All are fed at the top with a furnace chamber and a combustion chamber, usually separated by a bridge wall. Deodorization takes place in the former. Other topics covered included charging equipment, grates, ash handling, air supply, preheating air for combustion by various heaters, some made of heat-resisting alloys and refractory tiles, temperature and draft control, chimneys, instruments, auxiliary fuel, waste heat utilization, plant layout and building design. Mr. Eddy strongly recommends that the subject of waste heat utilization be looked into for economic justification, for though it is appealing there is difficulty in synchronizing refuse supply and steam demand.

Mapping

William Bowie, U. S. Coast & Geodetic Survey, outlined the status of mapping west of the Mississippi. Not more than 15 per cent of either the East or the West is adequately mapped, he stated, and ours is the most poorly mapped of the progressive countries of the world. The work could be done in 5 years and would cost only $11,000,000. Much of the western work would be by airplane.

Some 1,500 sq.mi. of area in Tennessee has been mapped by the stereographic method in the last 18 mo. according to W. S. Higginson, U. S. Geological Survey, who described the development of the process with the Aeroprojector-Multiplex. Four separate steps in map plotting are performed in the following order: Culture (works of man), contours, drainage and woodland.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

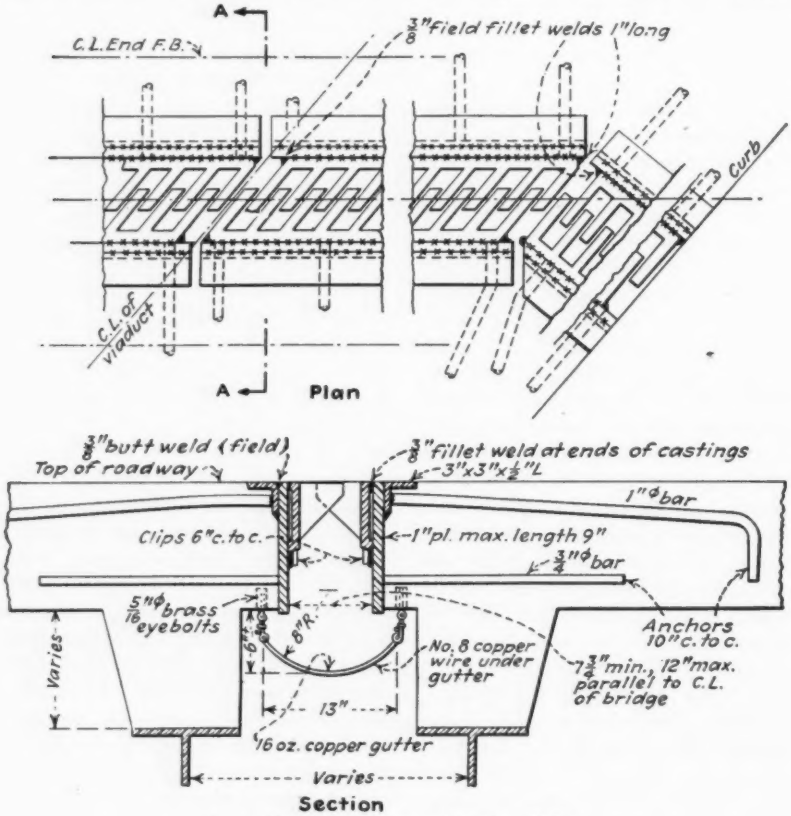
Welded Expansion Joint

TRUMAN P. YOUNG
Cincinnati, O.

An expansion joint of welded design with provision for easy field adjustment and replacement was developed for the deck of the new Columbia Ave. viaduct now being completed in Cincinnati. The viaduct consists of continuous truss spans between which are joints which have had to provide for as much as 3 in. temperature movement, plus clearance and setting allowances. To avoid the objections inherent in sliding types, an interlocking finger type was used, with cast steel fingers 5¼ in. long. Proper anchorage of this type of joint design is difficult to reconcile with adjustability, but a two-piece design was developed which was satisfactory.

The anchorage members consist of 1 in. reinforcing bars shop welded to a 1 in. thick vertical plate the full depth of the slab. An angle is welded to the top edge of the plate to stiffen it and provide a bearing on the concrete. These plates are set in the forms, and their top edges form the screeds to which the slab is struck. After concrete on both sides of a joint has been placed, the other part of the joint, the interlocking finger castings, are set, resting on lugs welded to the face of the 1 in. plates. They are then adjusted for side clearance and are welded continuously to the plates. This provides a means of adjusting small irregularities in the setting of the anchor plates or in the castings. The finger castings are furnished in short length, and any length can be removed by simply chipping or grinding out the continuous weld, which should simplify future adjustment.

J. E. Root is director of public works, and H. H. Kranz is city engineer of Cincinnati. The writer was in charge of superstructure design in a division set up to handle this viaduct job, under the supervision of Pusey Jones.



An adjustable finger expansion joint.

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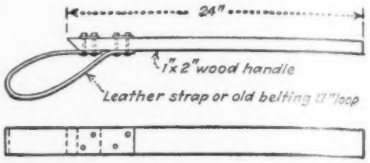
Wrench for Soils Laboratory

EDWARD A. ADBUN-NUR
Billings, Mont.

During the past few years in my work in soil testing laboratories, we have used a compaction cylinder modeled after the design of the U. S. Bureau of Reclamation. The cylinder is fastened to the base by wedging under lugs bolted to the latter. To separate the cylinder from the base, the usual procedure has been to hammer the corner of the base until it jarred loose. In time the corners became blurred, causing the base to rock when placed on the compaction bench besides making the apparatus unsightly.



A wrench for unlocking coil compaction cylinders.

The accompanying sketch shows a "wrench" put together in a few minutes from pieces of scrap which can be found around any laboratory. This makes it convenient to get the base off with very little effort.

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For Squaring Numbers

G. G. COMMONS
State Board of Water Engineers,
Austin, Texas

In squaring numbers, the engineer may often find one of the following methods to be of value. For convenience, they are stated algebraically, and numerical examples are given.

(1) $x^2 = (x - a)(x + a) + a^2$

$96.5^2 = (96.5 - 3.5)(96.5 + 3.5) + 3.5^2$

$= (93)(100) + 12.25$

$= 9300 + 12.25 = 9{,}312.25$

$6.75^2 = (6.75 - 0.75)(6.75 + 0.75) + 0.75^2$

$= (6)(7.5) + 0.5625 = 45 + 0.5625 = 45.5625$

(2) $x^2 = (x - a)^2 + (x - a/2)\ 2a$

$103.6^2 = (103.6 - 3.6)^2 + (103.6 - 3.6/2)\ (7.2)$

$= 100^2 + (101.8)\ (7.2)$
$= 10{,}000 + 732.96$
$= 10{,}732.96$

(3) $x^2 = (x + a)^2 - (x + a/2)\ (2a)$

$87.2 = (87.2 + 2.8)^2 - (87.2 + 2.8/2)\ (5.6)$

$= 90^2 - (88.6)\ (5.6) =$
$8{,}100 - 496.16 =$
$7{,}603.84$

The first method is usually the easiest to handle, the second and third methods are best used with tables of squares.

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Fastening Acoustical Blocks

RUSSELL C. BRINKER
Assistant Professor of Engineering, University of Hawaii, Honolulu, Hawaii

A convenient method of fastening 21,000 sq.ft. of acoustical blocks was developed for the Social Science building at the University of Hawaii.

Originally, tenpenny nails were driven on about 3-ft. centers from above until the points just came through the bottoms of the beam forms, the heads therefore, standing up inside the forms. In stripping the forms after pouring, the bottom board was pulled straight down, and when removed left about an inch of the nail point exposed. A ¾x3 in. board was then impaled on these nails, the points bent and the acoustical blocks nailed to the boards (Fig. 1).

Although this method gave satisfactory results, a suggestion by the inspector that a suspended ceiling type of wire fastening be used has been tried and found superior in the new building. Pieces of No. 11 wire about 18 in. long and spaced about 18 to 24 in. on centers were partly embedded in the steel forms of the pan floor system, with the ends pointing downward and passing out between the pans and the bottom of the forms. After removal of the forms, a ¾x3 in. board was placed against the bottoms of the concrete beams, and the wires looped under these boards and twisted until a rigid connection was obtained. Then ¾x3-in. cross pieces on 12 in. centers were nailed

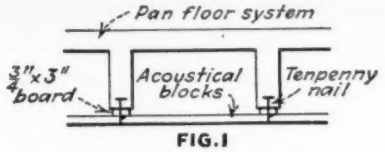

FIG. 1

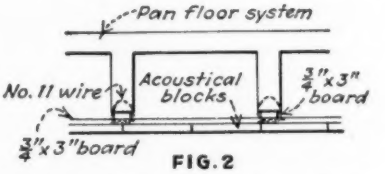

FIG. 2

to the wire-held boards, and the acoustical blocks in turn nailed to these pieces (Fig. 2).

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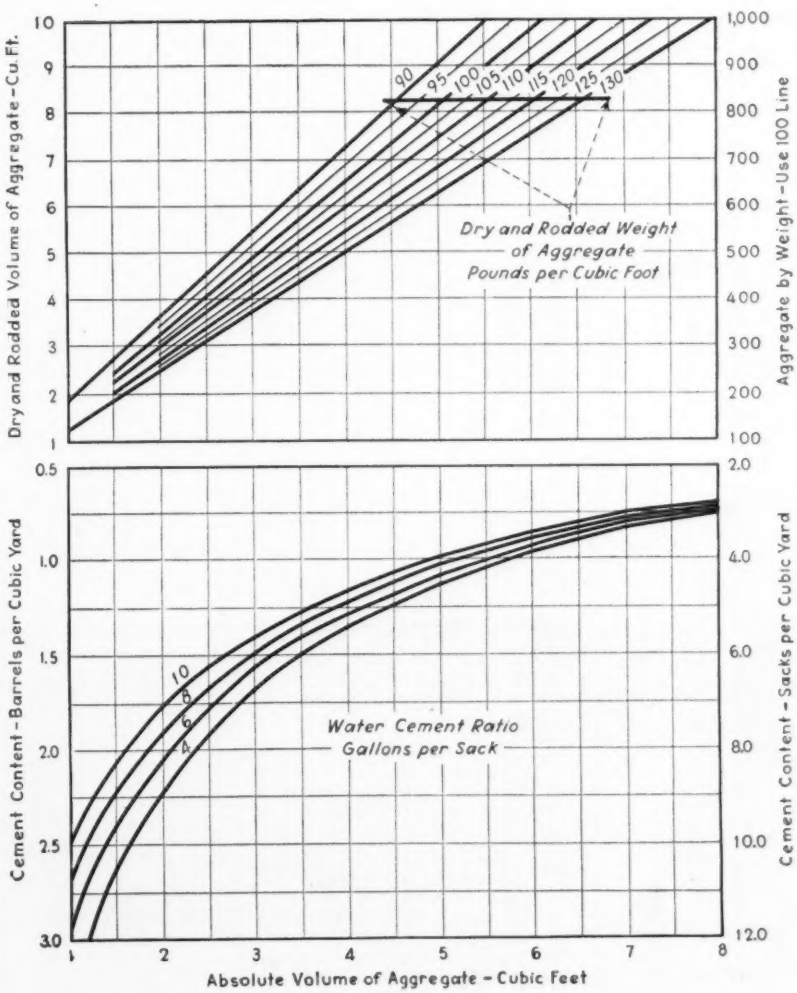
Chart for Mix Design

GEORGE WILEY
Engineer, Nebraska Cement Co., Superior, Neb.

The chart illustrated has several convenient uses in concrete mix design. For example, suppose a mix of 1:4 by volume is specified and is to be used with a 110-lb. aggregate: Following from the upper left hand scale "Dry and Rodded Volume of Aggregate" at line 4 to the intersection with the line marked 110; reading down to absolute volume of aggregate gives 2.7 cu.ft.; going on down to the proper line for water cement ratio (say 6 gal.) gives a cement content of 1.65 bbl. or 6.60 sacks per cu.yd.

If the mix is given on a weight of aggregate per sack of cement the upper right hand scale is used together with the line marked 100. In case where two aggregates are used the absolute volume of each is found and the two added together and then the corresponding cement content taken from lower chart. The chart can also be used in the reverse direction to find the volume mix when the cement content is given.

The chart is based on aggregate with a specific gravity of 2.62.



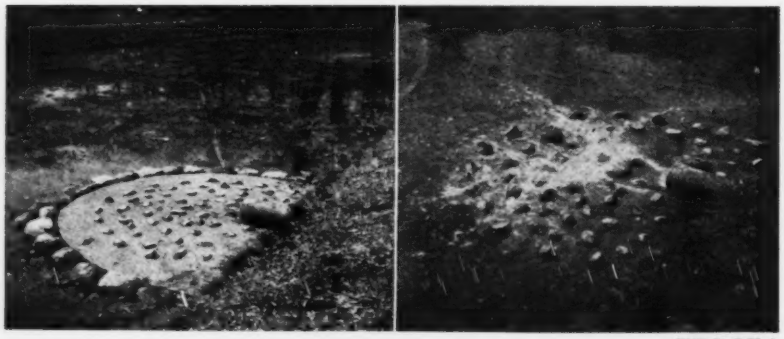
Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

BIOLOGICAL REFUSE DISPOSAL—Biological methods for refuse disposal are periodically placed on trial for the production of a low grade fertilizer or soil builder. The success of biological methods depends however upon the economic production of a saleable material and the efficiency of the material as a fertilizer. Recently Messent (*The Surveyor* Apr. 1, 1938) described a system which is claimed to produce a good fertilizer of a fibrous and cellular nature, free from pathogenic bacteria and unpleasant order. These results were obtained in an experimental plant treating the refuse of a town. After sorting, the material is placed on trucks, bacterial cultures are sprayed on it and the entire mass is then fermented in cells with capacities of 150 to 200 tons. Treatment is first anaerobic, followed by aerobic fermentation; the residue is removed mechanically and pulverized. It is stated that the results are distinctly promising, but no cost data are as yet available. The material is said to contain certain vitamins necessary for plant growth.

SEWAGE DISTRIBUTOR—A simple but effective method for distributing the discharge of sewage on a sand filter bed was devised at the Essex Fells, N. J. treatment plant as illustrated below. In order to reduce the high velocity of flow which eroded the bed in one point, 6-ft. diameter, semi-circular apron of concrete was constructed beneath the pipe and studded with irregularly-shaped stones about the size of a man's fist. Large boulders were then placed around the circumference slightly elevated above the concrete. The sewage stream emanating from the pipe strikes the projecting stones which creates considerable turbulence and thus reduces the hydraulic energy sufficiently to prevent any damage to the surface of the bed.

TWO-STAGE DIGESTION—On account of increased sewage loading as well as the retention of more sludge in secondary settling tanks the three single-stage digesters, Aurora, Ill., were converted to a two-stage system. (7th *Annual Report* Aurora San. Dist. 1937). After a few days of operation it was discovered that three zones of sludge were forming in the first stage digester. The upper zone, consisted of sludge with 12 to 15 per cent solids, the bottom layer contained about 3 per cent solids, and an intermediate zone varied from clear liquor to a thin sludge with 2 per cent solids. To reduce the load on the second stage tank and retain activity in the first tank the liquid overflow device was changed so that draw-offs could be made from any desired depth. This was accomplished by telescoping a galvanized iron pipe with long slots on opposite sides in the upper part through the emergency overflow pipe in the transfer box. In use, the sludge was prevented from rising in the transfer box by building up a head with the usual control rings. This arrangement caused the overflow from the first stage digester to discharge from any place in the center zone selected according to sludge concentration.



ENR Staff Photo

A concrete apron studded with stones reduces velocity of flow on a sand filterbed

MILK PLANT TREATMENT—Experimental purification of milk washings by double filtration has progressed to plant scale work. When milk washings are passed through trickling filters the fat and other solid matter deposited on the top layer of the filter eventually choke it. When the operating order of the primary and secondary filters is periodically changed (about every 3 weeks) no difficulties occur and the deposited matter gradually disappears. Plant scale operation has shown good results with rates of 120 gal. per day per cubic yard of filter stone. Experiments at higher rates of flow are reported (*Report* Water Pollution Research Board England, (1937) where the primary filter was supplied with settled liquor having a B.O.D. of 300 p.p.m. running the plant continuously at a rate of 240 gal. per cu.yd. a day. During a 2-month operating period the average B.O.D. of the filter effluent was less than 10 p.p.m. but the reversal of filters was made every week or ten days. Experimentation with the activated sludge process has been extensive but the process of biological oxidation with two trickling filters appears best.

SUPERNATANT DRAW-OFF—Thin sludge coming from digesters is concentrated to some extent after a short storage period. Where this occurs on a sand drying bed the water may be on top, between two layers of sludge or at the bottom. Stanbridge (*The Surveyor* 93, 570, 1938) tells of the construction of simple draw-offs to remove the separated water. They consist of brick chambers of which the side facing the bed is formed of 2 in. square boards. When it is desired to draw supernatant the joints between the boards are opened slightly by inserting match sticks. The water then passes through a layer of sand piled against the outer face of the wooden barrier and through the open joints into the chamber. The chamber also receives water from underdrains.